THURSDAY, JULY 29, 1915.

THE STUDY OF METALS AND ALLOYS.

An Introduction to the Study of Physical Metallurgy. By Dr. W. Rosenhain. Pp. xxii + 368. (London: Constable and Co., Ltd., 1914.) Price 10*s.* 6*d.* net.

IT may be doubted whether the title of this book has been happily chosen. So far as its subject matter is concerned, with the exception of one chapter on the mechanical testing of metals, it has hitherto been described by the term "Metallography." The latter, which dates back to 1721, was originally used to signify the description of metals and their properties. In this sense it is certainly obsolete, but it was re-introduced in 1892 to describe the microscopic structure of metals and alloys, since when, as Dr. Desch points out in his text-book, "Metallography" (Longmans and Co.), "it has been generally accepted, gradually receiving an extension of meaning to include investigations by other than microscopic means." Dr. Rosenhain, in using the term physical metallurgy to describe such subject matter, writes:—"The scope of physical metallurgy is an exceedingly wide one, and one which brings it well over the borderland of several sister sciences—such as chemistry on the one side, physics on another, and that branch of knowledge generally known as 'strength of materials' in yet another direction. Besides these, crystallography bears largely on our subject." This being the case, it appears to the writer that "Metallography" is the more appropriate title, as being both more accurate, more inclusive, and better suited to a rapidly growing science. Nowhere in this book, so far as can be seen, does the author attempt to bring the terms "Physical Metallurgy" and "Metallography" into relation with each other, and there are places where he appears to use them as interchangeable expressions.

The book is divided into two parts. The first deals with the structure and constitution of metals and alloys, the second with the properties of metals as related to their structure and constitution. As the title indicates, it is an introduction to a particular type of study, but it also serves as an introduction to a metallurgical series which is in course of publication under the author's editorship. This being so, he writes:—"The treatment of the whole subject in the present work has been intentionally kept somewhat general, the object of the author being to awaken interest and to stimulate thought and ideas rather than to communicate a great mass of detailed data." The author has certainly achieved his purpose. He has written an interesting book full of suggestions, and he has presented his subject with remarkable fairness, and due acknowledgment to other workers. Chapter xi, dealing with the effect of strain on the structure of metals, a field of investigation in which he has been one of the pioneers, is one of the best pieces of writing extant on this subject.

No one acquainted with Dr. Rosenhain's technique will be surprised to hear that the photographic illustrations are excellent, but some of the diagrams are far from satisfactory. In describing the copper-aluminium equilibrium, certain letters are used in the text which are obviously meant to correspond to similar letters in the constitutional diagram, but which are conspicuous there only by their absence. It is somewhat surprising to come across the statement (page 110):—"No investigation of the constitution of a system of alloys can be regarded as really complete until a study of electrical conductivities and temperature coefficients has been carried out." Very few systems are composed of alloys which are ductile from one end of the series to the other. In the great majority of cases, as the author himself points out, there exists in the middle regions of the binary series a zone of brittleness and weakness where, not only can the alloys not be drawn into wires, but where they cannot even be turned in a lathe. Determinations of electrical conductivity would in such cases have to be made on rods cast to shape, and owing to their proneness to contain cavities or blow-holes, they would not be suitable for exact work and therefore as evidence in questions of constitution. Microscopical and thermal analyses still remain the fundamental methods of investigation in the determination of the constitution of alloys, and in most cases they are sufficient.

The author regards as anomalous and as requiring further research (page 305) the fact that α brasses cannot as a rule be hot-rolled (although they can be cold-rolled) whereas $\alpha + \beta$ brasses can be hot-rolled even though β is considerably harder than α. He mentions, however (footnote to page 145), that he has recently seen an α brass successfully hot-rolled, and suggests therefore that "the hot shortness of the brasses may not be an inherent property of the alloys." In reality the explanation is quite simple. Lead is an invariable constituent of all commercial brasses. It is almost insoluble in α brass and the red shortness of this material is due to the presence of films of liquid lead among the solid α crystals. If, however, α brass is made from copper and zinc free from lead it can be hot-rolled without difficulty. The

β constituent, on the other hand, dissolves lead appreciably above 470° C., and hence at the temperature of hot rolling the α+β alloys do not contain liquid lead and are not hot short.

H. C. H. CARPENTER.

PENCIL AND PEN IN SYSTEMATIC ZOOLOGY.

(1) *Catalogue of the Amatidae and Arctiadae (Nolinae and Lithosianae) in the collection of the British Museum.* By Sir G. F. Hampson. Plates i–xli. (London: British Museum (Natural History) and Longmans, Green and Co., 1915.) Price 33*s.* 6*d.* net.

(2) *A Revision of the Ichneumonidæ based on the Collection in the British Museum (Natural History), with Descriptions of New Genera and Species. Part iv., Tribes Joppides, Banchides, and Alomyides.* By C. Morley. Pp. x+167. (London: British Museum (Natural History) and Longmans, Green and Co., 1915.) Price 6*s.*

(3) *The Syrphidae of the Ethiopian Region based on Material in the collection of the British Museum (Natural History), with descriptions of New Genera and Species.* By Prof. M. Bezzi. Pp. 146. (London: British Museum (Natural History) and Longmans, Green and Co., 1915.) Price 6*s.*

(4) *British Museum (Natural History): British Antarctic ("Terra Nova") Expedition, 1910. Natural History Report. Zoology, vol. i., No. 3, Cetacea.* By D. G. Lillie. Pp. 85–124. (London: British Museum (Natural History) and Longmans, Green and Co., 1915.) Price 7*s.* 6*d.*

(5) *Catalogue of the Fresh-Water Fishes of Africa in the British Museum (Natural History).* Vol. iii. By Dr. G. A. Boulenger. Pp. xii+526. (London: British Museum (Natural History) and Longmans, Green and Co., 1915.) Price 2*l.* 5*s.*

(6) *The Fauna of British India, including Ceylon and Burma. Mollusca (Fresh-water Gastropoda and Pelecypoda).* By H. B. Preston. Pp. xix+244. (London: Taylor and Francis, 1915.) Price 10*s.*

(7) *British Museum (Natural History): British Antarctic ("Terra Nova") Expedition, 1910. Natural History Report. Zoology. Vol. ii., No. 4, Mollusca. Part i., Gastropoda Prosobranchia, Scaphopoda, and Pelecypoda.* By E. A. Smith. Pp. 61–112. (London: British Museum (Natural History) and Longmans, Green and Co., 1915.) Price 4*s.*

MODERN researches provide a well-trained army of naturalists with an almost overwhelming supply of material. A vast literature has to be examined to make sure that species apparently new to science have not been already described. Assistance is afforded by elaborate monographs of separate groups, such as Sir George Hampson's monumental catalogue of the Lepidoptera Phalænæ, in thirteen volumes. But there is no finality in these obliging auxiliaries, for, as usual, while Sir George's catalogue was being issued between 1898 and 1913 other workers were industriously making it incomplete, so that already the monographer has had to provide a supplement, beginning with a first volume of nearly 900 pages. Some complication in descriptive work is also unavoidable, when several independent expeditions make their way to the same goal, as within the last few years has been the case with ships visiting the antarctic region and exploring the marine fauna at stations along the route.

To meet the initial difficulties in investigation of species nothing is more time-saving to the naturalist than trustworthy illustrations of the group he is studying. Faithful colouring is in some parts of the animal kingdom an additional boon of great value. The drawback is the initial costliness of production, and, consequent upon this, prohibitive prices forcing the student in many instances to rely upon borrowed copies or occasional visits to distant libraries. During the last two centuries the extreme desirability of well-illustrated zoology has been evidently fully appreciated though very variously provided for. Among individual efforts none is more remarkable than that of the Dutch physician, Albert Seba, who in the first half of the eighteenth century must have spent a fortune over the production of his 450 large folio plates, many of which are double. Latreille in 1830 commended them as excellent, though he condemned the "Accurata Descriptio" as worthless. At the same period Cuvier and his colleagues paid the plates an extraordinary compliment by re-issuing the whole mass with a brief revision under the editorship of Guérin. Just then, also, the French Government was issuing 198 rather larger and much more refined plates, illustrating the voyage of the *Astrolabe*, to which Mr. Edgar A. Smith makes several references in his recent memoir.

As the accomplished authors whose works are mentioned at the head of this notice must all be acutely conscious of the expediency of doing unto others as they would that others should do unto them, it is interesting to compare the different ways in which they have dealt with the supply of illustration. (1) The forty-one plates of Hampson's supplementary volume are filled with delicately coloured representations seemingly of all the species recorded in the supplement which have

not been previously figured. An economy now commonly practised, and no doubt very necessary, shows the wings only of one side. This should redeem from heartless ridicule the proverbial pig with only one ear, but by depriving the moth or butterfly of its bilateral symmetry it makes it somewhat of an artistic failure. A carcinologist is apt to find variation in colour-marking very untrustworthy for specific distinction. The entomologist, on the other hand, appears to rely upon it with considerable confidence.

(2) This is further exemplified in Mr. Claude Morley's revision of the Ichneumonidæ, although, so far as illustration goes, that work is in striking contrast to the generous treatment of the Lepidoptera. For Part iv., with more than forty new species, has only a single figure. This one example, however, is furnished with the full complement of wings, antennæ, and hexopodal appurtenances, and is to some extent suggestive of the "remarkable grace and beauty, combining delicacy of outline with both fine and brilliant, not infrequently metallic, coloration," which Mr. Morley claims for the objects of his study. It is rather unfortunate that the plate unmistakably shows an insect in which the wings have each a brown band and brown apex, while the *Joppa nominator*, Fabricius, which it is said to represent, is described by Fabricius as having "alis omnibus fascia apiceque nigris" ("Ent. Sys.," vol. ii., p. 158, 1793). Mr. Morley reveals without explaining the discrepancy.

(3) Prof. Bezzi's work on the African Diptera of the family Syrphidæ is less abstemious in the matter of illustrations, and, besides a useful explanatory diagram, furnishes very full and important keys for the discrimination of the genera and species. Mr. C. J. Gahan's verdict may well be accepted that the present treatise "greatly advances our knowledge" of the group. There are said to be about 2300 described species, and the difficulty of dealing with them is attested by E. Brunetti, who some years ago said of the genus *Syrphus*, "this genus I do not touch upon at present in view of the large number of supposed species described from Oriental regions, and their close affinities" ("Records Ind. Mus.," vol. ii., p. 57, 1908).

(4) Passing now from the air to the water, it will be found that Mr. D. G. Lillie gives as many illustrations of the Cetacea as could be expected from his opportunities, seeing that he starts with the acknowledgment that the *Terra Nova* "did not succeed in capturing any specimens of this group." He mentions the belief of whalers that humpback whales rub themselves against rocks to get rid of the Balanid *Coronulae*. To this opinion there are two objections: one, that with the Coronula once fixed in the whale's soft skin, more irritation would probably be caused by rubbing it off than by leaving it alone; the other, that the soft-stalked Lepadid Conchoderma so curiously and prominently planted on the Balanid implies that the Coronula is a place of exceptional security.

(5) Dr. G. A. Boulenger's fine catalogue of fresh-water fishes of Africa is now continued in a third volume, with promise of a fourth. The species described are 394, and there are 351 text-figures, 45 of them species not in the British Museum collection. It is pleasant to observe that for the *Muraena anguilla* of Linnæus Dr. Boulenger accepts the name *Anguilla vulgaris*, Turton, in place of the barbarous tautology in which some authorities delight. In dealing with the Cichlidæ, which occupy three-fourths of the present volume, he is forced to admit that Nature is sometimes very ill-natured to the conscientious systematist, spoiling the best-laid schemes of classification by a very inconvenient interlacing of characters. This appearance, however, of what our distant cousins call *Schadenfreude* is not due to a pure delight in mischief, but is the simple result of that universal consanguinity in which the sincere evolutionist is bound to believe. In a synopsis of 41 genera, and a further synopsis of a genus with 94 species, there are pretty sure to be some entanglements. To lovers of odd fishes, *Psettus sebae* may be commended, with its "body deeper than long," a species figured life-size by Seba as *Chaetodon quadratus*. The mouth of *Corematodus shiranus*, Boulenger, must be useful for hygienic mastication, but disagreeable to its prey, as its massive jaws are fitted with "extremely broad bands of innumerable minute club-shaped teeth."

(6) In Mr. Preston's treatise, "wherever possible, illustrations of hitherto unfigured species have been given." The author regrets that he "can, in most instances, only deal with the shells of the species quoted," material for anatomical work not being available. But in his Introduction he is able to give several interesting bionomic notes, and for the anatomy of one species, *Mulleria dalyi*, Smith, he has a sad satisfaction in quoting largely "from the late Mr. Martin F. Woodward's invaluable Paper on the subject." In some of his references Mr. Preston leaves the student rather in the dark. Thus he cites:—"*Theodoxis*, de Montfort, Conch. Syst., ii., 1810, p. 350; *Neritina*, Lamarck, 1822 [*Neritine*, 1809]. Type, *T. lutetianus*, de Montfort (*fluviatilis*, Linn.)", without saying whether Neritine is French or Latin, or where it is to be found, and without showing that p. 350 in de Montfort is only a plate,

while the description of genus and species on p. 351 gives the authoritative spelling in the name *Theodoxus lutetianus*.

(7) The numerous new species described in Mr. E. A. Smith's treatise are illustrated in two excellent plates. Mr. Smith's mastery of the subject almost forbids criticism, but may still excuse inquiry in regard to his use of the generic names Rissoia and Panope. In the "Discovery" Gastropoda, 1907, he transferred without explanation his *Rissoa adarensis* to Rissoia. Under *Rissoia adarensis* (Smith) he now adds a note: "A synonym of *Rissoa* is *Apanthausa*, Gistel ('Naturgesch. Thierreichs,' 1848, p. x)," without explaining what is the relationship of Apanthausa to Rissoia. In 1850, Gistel in the "Handbuch der Naturgeschichte," p. 554, declares that Rissoa must be changed (though he does not say why) into his Anatasia, the date of which is given by Scudder as 1848. Neither Gistel in 1850 nor Scudder later on makes any mention of Apanthausa. A further perplexity is caused by Mr. Smith's change of *Panopaea zelandica*, Quoy and Gaimard, into *Panope zelandica*, without any reference to show that Panope, as the name of a molluscan genus, antedates its use in 1813 by Leach for a genus of Crustacea. Les "Panopes," Lamarck, Ann. du Mus. Paris, vol. x., p. 394, 1807, is a French term.

T. R. R. STEBBING.

CHIEFLY MONGIAN GEOMETRY.

(1) *Descriptive Geometry for Students in Engineering Science and Architecture. A Carefully Graded Course of Instruction.* By Prof. H. F. Armstrong. Pp. vi+125. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1915.) Price 8*s*. 6*d*. net.

(2) *Geometry of Building Construction: Second Year Course.* By F. E. Drury. Pp. xii+226. (London: G. Routledge and Sons, Ltd., 1915.) Price 3*s*. net.

(3) *Practical Science and Mathematics.* By E. J. Edwards and M. J. Tickle. Pp. viii+175. (London: G. Routledge and Sons, Ltd., 1915.) Price 1*s*. 6*d*. net.

(1) THE geometry of Monge, in which three-dimensional bodies are represented by plan and elevation, is one of the most educative branches of mathematics; and yet it is taught in this country only as a technical subject for engineering and architectural purposes. The secondary school is unaware of its existence. Hence the pleasure with which we find a Canadian writer on the subject reckoning that his book will be used in high schools. Let us hope that the good traditions of Canada will be adopted by England. The book covers the usual ground. The problems are based on the usual conventional figures. The book is beautifully got up, the text and figures both being admirable.

(2) This book is also on Mongian geometry. In place, however, of the conventional subjects, it treats real problems of building construction throughout. It is, in fact, intended as a builder's text-book. Just on that account it forms a suitable book for any student of Mongian geometry. The propositions of the subject presented in the abstract are too difficult for the majority of students. The treatment of the propositions as inductions from concrete problems makes them much easier to grasp and to retain. This distinction is realised by the author and forms the basis of the book, as indeed it does of the whole series. The book is certain to have a wide sphere of usefulness.

(3) This book also belongs to the excellent series edited by Mr. Udny Yule. It is concise and clear, the style simple and direct. The inductive method is wisely followed, a number of particular cases being followed by a generalised statement. It is a useful book, and avoids confusing the mind by excess of abstract reasoning. There is a generous use of graphs, and the only fault we find is the failure to emphasise the fact that the "algebraic law of the relation between two quantities" $y=ax+b$ is only one among many possibilities.

ELECTRICAL ENGINEERING TEXT-BOOKS.

(1) *A Treatise on the Theory of Alternating Currents.* By Dr. A. Russell. Vol i. Second Edition. Pp. xiv+534. (Cambridge: At the University Press, 1914.) Price 15*s*. net.

(2) *Electrical Engineering.* By Dr. T. C. Baillie. Vol. i. Introductory. Pp. vii+236. (Cambridge: At the University Press, 1915). Price 5*s*. net.

(3) *Electrical Instruments in Theory and Practice.* By W. H. F. Murdoch and U. A. Oschwald. Pp. viii+366. (London: Whittaker and Co., 1915.) Price 10*s*. 6*d*. net.

(4) *Alternating-Current Electricity and its Applications to Industry.* First Course. By W. H. Timbie and Prof. H. H. Higbie. Pp. x+534. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1915.) Price 8*s*. 6*d*. net.

(1) A NEW edition of Dr. Russell's book will be welcomed both by physicists and electrical engineers, particularly by those who

have to teach advanced students. The addition of greatest interest to electrical engineers is the chapter dealing with the theory of coupled electrical circuits. This subject is now of great importance in wireless telegraphy and a simple and complete statement of the theory, such as that worked out by Prof. Fleming or that contained here, is of great value. The tables for determining high-frequency resistance and for estimating the inductance of coils and for calculating the effective capacity of a long antenna should also be of importance to radiotelegraph engineers. It is impossible, in a short notice, to describe adequately the vast field of theoretical work that the book covers, or to do justice to the masterly treatment of the many problems with which it deals. The book has already taken its place as a standard work on alternating current theory, and the additions made in this new edition will tend to establish it more firmly in the position it has already attained.

(2) The opening chapter of Dr. Baillie's book on electrical engineering contains a useful summary of the pioneer work on which the modern practice of electrical engineering rests. Brief reference is made to the work of Volta, Galvani, Siemens, Ampère, Clerk-Maxwell and many others. At the present time it is perhaps of interest to note that among those whose names are household words in electrical science, only two, those of Siemens and Hertz, are of Teutonic origin. The following chapters deal with the ordinary phenomena of electrical conduction, the measurement of resistance power and current, about which all elementary students in electrical engineering have to learn, together with chapters on batteries and the electric light.

Special mention may be made of chapter vii, which deals extremely well with the potentiometer and its uses, and to the chapter on batteries, which is exceptionally clear and good. The book is sufficiently elaborate to meet the needs of students taking a first year course in a technical college Some doubt may be expressed as to the value of such figures as 18, 19, 20, 21, 24, 25, 26, which show the outer cases of instruments. This, however, is a minor defect; the illustrations do not detract from the value of the book, they merely add unnecessarily to its bulk. As a text-book for elementary courses in electrical engineering it should fulfil a useful purpose, a result which is greatly assisted by the 125 examples, to be worked by the students, which are given at the ends of the chapters.

(3) The book by Messrs. Murdoch and Oschwald on electrical instruments is a welcome attempt to discuss the design and construction of electrical instruments from the broadest point of view. The theory of their action and their mechanism is clearly laid down. The opening chapter contains a brief summary of the history of exact measurement together with a short account of some absolute determinations of the fundamental electrical quantities. In this connection it is interesting to note that so recently as 1881 Kelvin and Bottomley stated that "the most accurate method of measuring candle power was by comparing the shadows of a pencil illuminated by the two sources." The summary shows clearly how the development of electrical instrument construction is related to the practical needs of the industry.

In an interesting chapter on damping, the general theory is laid down and discussed in connection with the instruments in which it forms an essential feature, the Grassot fluxmeter being, of course, the outstanding example. The following chapters describe the ordinary form of moving coil ammeter, electrostatic and current voltmeters, hot wire instruments, dynamometer type instruments, and energy meters. In the chapter on magnetic testing a suggestion is made to resuscitate the old magnetometer method of testing with weak fields. This method is an admirable one under suitable conditions, but in a laboratory within range of an electric tramway or railway, or even of electric light mains, it is nearly useless. There are numerous figures and results given throughout the book which have been obtained from the authors' own requirements, which are of value as independent testimony to the accuracy of the apparatus with which they have been made. The book should be a useful work of reference for those who are engaged in the manufacture of electrical instruments and in electrical testing.

(4) The book on alternating current electricity and its application to industry by W. H. Timbie and H. H. Higbie is an attempt to simplify the teaching of alternating current technology for engineering students. The teaching of this subject has advanced with great strides since the time, some twenty years ago, when the study of alternating currents was regarded as a branch of applied mathematics, to be taken after an elaborate introductory mathematical training. Alternating current work should form part of a normal second year course for all engineering students, and this book is one which should be most useful as a text-book for helping in the teaching of this subject during the early stages. The hydraulic analogies in many cases are ingenious and enlightening, and explain the apparent incon-

sistencies met with in alternating current work. The only serious criticism that may be offered is that it attempts rather too much. For example, in Problem 55, on p. 275, the student is asked to calculate the self-induction of a long three-phase transmission line, and in the next question to calculate the corresponding reactance. He might be led to expect that this result would give him the drop of the line, whereas it does not, because the mutual induction between the lines and the difference in phase between the currents in the lines are not taken into account. One might also be inclined to criticise the amount of space devoted to the subject of armature windings for alternators. This is defended in the preface, as a useful mode of teaching polyphase current technology. In practice an oscillograph demonstration of phase differences would be much more illuminating. The order of taking up the subject, too, strikes one as rather unnatural. It is surely a mistake to leave out any reference to the physical nature of self-induction and capacity until reactance has been studied.

The argument from the concrete example to the abstract theory is much used in America and elsewhere, and possibly has advantages for engineering students; the danger of it is that the student, when he can calculate what he wants to calculate about his machines, will often never bother to find out the reasons for his methods; he will become a rule-of-thumb man instead of a scientifically trained engineer. The danger is a very real one, which must be combated if engineering students are to become useful in engineering development work, the work for which engineering colleges should strive to train their men. In spite of minor defects, the book may be recommended as a satisfactory text-book for students of electrical engineering in the early stages of their training.

OUR BOOKSHELF.

The Electric Dry Pile. By C. E. Benham. Pp. 37. (London: P. Marshall and Co., 1915.) Price 1*s.* net.

THIS little book is a reprint of articles published in the *English Mechanic* during the present year. The dry pile, built up in the same way as Volta's moist pile, was the invention of Jean André De Luc, who first described it in *Nicholson's Journal*, 1810. It was constructed by piling up in a glass tube a series of paper discs, coated on one side with silver leaf and on the other with thin leaves of zinc. A continual difference of potential was found to exist between the terminals. Modifications were introduced by various workers, notably Zamboni and Singer. The latter devised the form of apparatus now in the Clarendon Laboratory of the Oxford University Museum. This is arranged to ring a small bell, and its period of activity now extends to seventy-five years. Mr. Benham gives detailed instructions for setting up a dry pile of 2000 pairs, and describes a number of interesting experiments that may be carried out with its aid. The chief original feature is the use of two ready-made coated papers in the construction of the pile. The work would have been of greater scientific value if some quantitative results had been included.

War Map of Italy and the Balkan States. 30 in. × 40 in. (Edinburgh: J. Bartholomew and Co., n.d.) 1*s.* net in case, or 2*s.* 6*d.* on cloth in case.

THIS map covers an area extending from Geneva in the west to Odessa and Asia Minor in the east. On the north it reaches Vienna, and takes in Malta on the south. Insets, on large scales, of the Dardanelles, Constantinople and its environs, and Trieste and its surroundings are provided. Each separate State is distinguished in colour, and railways are shown. The map, which may be highly recommended, can also be obtained on rollers and varnished for 6*s.*

All About Zeppelins and other Enemy Aircraft. By F. Walker. Pp. 32. (London: Kegan Paul, Trench, Trübner and Co., Ltd., 1915.) Price 6*d.* net.

IT appears, from the preface, that "this little book is intended to explain fully, to a person of average intelligence, the nature and construction of enemy aircraft . . ." The author is a civil engineer, if one may so interpret the letters appearing after his name, but it is clear that his engineering training did not include an adequate course in aeronautics, or even freehand drawing, otherwise one might have been spared the many inaccuracies to be found in the book, and the still more remarkable sketches (signed "F. W.") purporting to represent aircraft. Fig. 20, page 25, is said to show "a British biplane in flight." It is in reality a very poor sketch of the Wright biplane of 1908, to the under-carriage of which the artist has added a misrepresentation of four wheelbarrow wheels. A somewhat better sketch of a *rear* view of the same machine is introduced in the following words: "Several of the Allies' biplanes have two propellers, as shown by the *front* view of a machine, Fig. 21."

Figs. 22 and 23 purport to be sketches of a "Taube" and an "Aviatik" respectively. Mr. Walker seems to have had misgivings, for he says: "But the details of these are so constantly changing, and the fact that they are utterly wrecked on reaching the earth, that we can only present the outward appearance in flight" (*sic*). It is difficult to believe that the delightful humour of these drawings, and of many of the statements in the book, is unintentional.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

More Early Animal Figures.

THERE is no better history of the rhinoceros, covering the knowledge of this animal in antiquity, than the essay contributed by Dr. Barthold Laufer to vol. xiv. of the Anthropological Series of the Field Museum

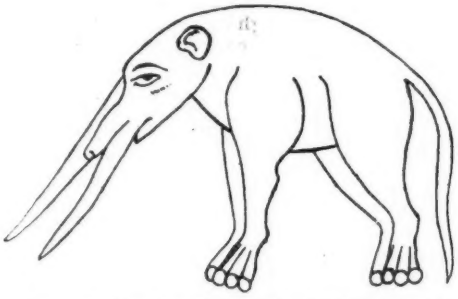


FIG. 1.—Elephant, from a Latin bestiary of the latter part of the 12th century.

(1914). It is illustrated by numerous figures copied after early designs.

Two recent popular articles in English magazines deserve notice in this connection. One is by W. P. Pycraft, on the "Ancient Briton War-Horse," which appeared in the *Illustrated London News* for October 31 and November 28 of last year. The other is on

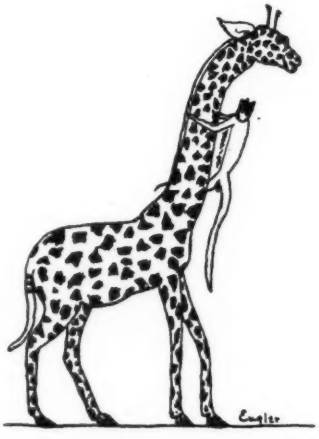


FIG. 2.—Giraffe, from a tomb at Thebes. Middle dynastic.

"Mediæval Ideas of the Elephant," by E. D. Cuming, in the *Field* for April 3 of this year.

One of the figures illustrating the latter article is here reproduced (Fig. 1), and we may also quote the following passage:—

"About few animals did our ancestors weave more curious and fantastic legends than they built up round the elephant. This animal captured their imagination, and no traveller's tale concerning it could be too marvellous to ensure acceptance."

In Figs. 2 and 3 are shown copies of two early Egyptian representations of the giraffe. The first of these is from manuscript 29,817 of the British Museum, already published in a coloured plate of

FIG. 3.—Giraffe, from an incised palette at Hierakonpolis. Early dynastic.

Wilkinson's "Ancient Egyptians," vol. i. The second is from an incised slate palette found at Hierakonpolis, figured by Quibell in "Memoirs of the British Exploration Fund." The probable period to which it may be assigned is early dynastic, or roughly, *circa* 5000 B.C.

G. R. EASTMAN.

American Museum of Natural History.

The Magnetic Storm and Solar Disturbance of June 17.

THE argument appears to me to drift again towards the old wrangle whether a particular solar disturbance has contributed to this or that particular magnetic storm. This is to me all the more surprising as for years past it has been urged that to connect the two phenomena in this direct way was to be deprecated and scientifically unsound; Fathers Cortie and Sidgreaves taking up a particularly uncompromising attitude in this respect.

I had the sun under telescopic as well as spectroscopic observation for many hours on twenty-seven out of the thirty days of last June, being prevented from doing so only on June 10, 23, and 29.

I submit that the mere telescopic appearance of a spot outbreak is not a safe index and criterion as to its activity, and consider that spectroscopic evidence should accompany ordinary direct visual observation. Now there was plenty of such evidence during the greater part of June, though spots were, at least at the beginning of the month, not very abundant. With June 12, however, things began rapidly to improve in this respect, a period of most intense activity being initiated by that most extraordinarily short-lived and superlatively active outbreak in abnormal low latitude (north) for the present phase of the activity period. The unprecedentedly rapid growth of this outbreak, which was really of an "explosive" intensity, was almost matched by an extraordinarily rapid decay, so much so that in spite of the magnitude the outbreak attained at its

maximum, it did not even complete the one transit as a spot group, but merely as a faculic area.

Now this particular disturbance was presently accompanied by quite a number of others, which passed through similar stages of rapid growth, and in some cases of decay. Thus the southern activity belt, which had just previously been decidedly quiescent, showed within a few days no fewer than five distinct outbreaks extending over a longitude of some 140° or less (June 16), to which yet another was added by June 21, while in north latitude we had some four outbreaks, amongst which two formed the largest then on view.

The simultaneous eruptive paroxysms witnessed from June 13 to June 24 were so numerous that to me it appears utterly futile to endeavour to link a particular magnetic disturbance during those days with any of these scores of violent commotions. With such a multiplicity of intensely active foci scattered over the sun's disc all that can be safely claimed is to point to an undoubted abnormal magnetic terrestrial condition coincident with an abnormally active sun.

In NATURE for July 15 you give an interesting report of a fine aurora having been seen by Prof. Barnard at Yerkes Observatory in the night of June 16–17. Mention has also been made of a sudden magnetic disturbance as early in that month as June 7, by Dr. Chree, but I see no report from these two observers as regards a very fine auroral display which a trustworthy Canadian observer has reported to have taken place late in the evening of June 12. The same Canadian observer also witnessed the display of the evening of June 16, and there can be therefore no confusion of dates. I wish to lay emphasis on the auroral display of the night from June 12–13, because it practically coincided with the explosive development of a spot-outbreak near the east limb, which I witnessed in the early morning hours of June 13. The Greenwich (and other) photographs will bring the proof of the quite unprecedentedly quick development and decay of that particular solar outbreak, which reached a stupendous magnitude within less than two days in an abnormally low latitude, and accompanied by a display of activity, as witnessed through the spectroscope, of an intensity rarely seen.

ALBERT ALFRED BUSS.
"Barrowdale," 22 Egerton Road, Chorlton-cum-Hardy, Manchester, July 18.

Cement for Polarimeter Tubes.

IN NATURE of February 25, 1915, was printed a letter from me requesting suggestions for a cement suitable for fastening the end discs of polarimeter tubes in such a way as to resist the action of organic liquids at high temperatures. Several gentlemen kindly wrote to me privately making useful suggestions, and it may perhaps be of value to someone else engaged upon similar work if I mention briefly what these suggestions were.

Mr. O. L. Brady, of the Imperial College of Science, proposed fused silver chloride. Mr. Wm. Doran, Liverpool University, describes a zinc oxychloride cement, and another made by mixing a thick mucilage of gum acacia with calomel. Dr. Pickard suggests litharge and glyceric acid, but adds "that there seems to be some trick in regard to its application." Mr. Thomas Steel, of the Colonial Sugar Refining Co., Sydney, N.S.W., in a letter which the editor has forwarded to me, describes a preparation he has used for many years for cementing glass tubes into metal holders, etc. "A soft putty is made of litharge and glycerine, and used just like plaster of Paris, allowing about sixteen hours for setting. The hard-set compound resists water, oil, or alcohol, and is quite air-tight." I believe that a mixture of gelatine and acetic acid is also used as a cement, but to what extent it is resistant I do not know.

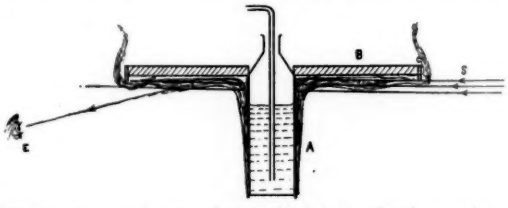
Another ingenious method of making a good joint, due, I understand, to Prof. W. Ostwald, was recommended to me, curiously enough, by M. le docteur Dolne, of Liège, a visitor amongst us on account of the war. By covering the centre of the disc with wax, and then immersing in an ammoniacal silvering solution, an annulus of silver is deposited on the disc, where it would come in contact with the end of the tube; the ends of the glass tube are treated similarly. Alternatively a deposit of platinum-black may be produced by moistening with platinum chloride solution and subsequent heating. The discs are then placed in position, the tube filled with a suitable silver or gold solution, one of these metals being then deposited electrolytically on the surfaces already silvered, or platinised, until the joint has become perfectly tight. The only question which might arise in regard to this seal is that, on heating, the different expansion of the glass and the metal might possibly cause leakage.

As the resisting power of most of these cements could not be definitely guaranteed by their suggesters, and the investigation of them all would constitute practically a research in itself, I followed the line of least resistance, and have tried, in the first place, a commercial preparation, "Cæmentium," recommended to me by Dr. J. R. Henderson, of the Royal Technical College, Glasgow. This is prepared by the Cæmentium Co., Ltd., Tanner Street, Bermondsey, London. Two tubes cemented with this material have stood well so far, resisting the action of boiling water and of some organic liquids up to temperatures of about 150°. A third broke down in the same circumstances, but was perhaps not properly cemented. I propose to try some of these other cements as occasion may require. In the meantime, any readers of NATURE seeking for such a substance may find amongst these suggestions one likely to be suitable for his particular purpose. I should like, in conclusion, to thank the gentlemen who have so kindly assisted me with their proposals.

T. S. PATTERSON.
Organic Chemistry Department,
University of Glasgow, July 15.

Experiment on Sunset Colours.

EVERYONE is more or less familiar with the coloured halo around a light when viewed through a bedewed window, and the streaks of colour which a cloud of vapour presents in a strong light. The purity of colour in the diffraction halo depends essentially on the uniformity of size of the condensed droplets, and



the same remark may be applied to a cloud or mist. It occurred to me that the colours of a mist or cloud could be made more brilliant and extensive by controlling in some way the motion and distribution of the differently sized suspended droplets. I have accomplished this partially by the following apparatus.

The cylindrical surface of a tin can A was wrapped closely with a sheet of thick blotting paper and supported in an upright position. A board B about 2 ft. square, with a central hole in it, was fitted over the

can in a horizontal position. Narrow strips of wood were nailed to the edges of the board to form a shallow ridge. One of these strips C was made adjustable. The blotting paper was moistened with water, and this was evaporated by blowing steam through the water in the can. The water vapour at a temperature of about 80° will stream steadily upwards from the surface of the can and flow over the board in an undulating cloud, separated from the surface of the board by a thin transparent layer of uncondensed vapour. On illuminating the cloud with a nearly horizontal beam of sunlight S, large patches of gradually changing colour appear when the eye E is directed slightly upwards towards the lower surface of the board. The beam of sunlight should be adjusted so that it just fails to illuminate the surface of the board, and the colours are best seen when this surface is blackened. The air around the board should also be quite undisturbed. These colours rival in brilliancy those to be seen on soap films, and present the features of sunset colours. It appears, then, that some of the brilliancy and extensiveness of sunset colours is due to a quiescent state or regular motion of the clouds or mist at sunset, and also to a distribution into layers of droplets of nearly uniform size.

F. W. JORDAN.

South-West Polytechnic, Chelsea, S.W.

Non-Poisonous Character of Nitroglycerin.

WITH regard to the dose of nitroglycerin referred to in the notice of a book in NATURE of July 22 (p. 560), it may be useful to have the facts correctly stated. The reference was clearly to a passage in the "Extra Pharmacopœia" (sixteenth edition, vol. i., p. 527), in which I say:—"An employé in the author's laboratory (1905) ate a piece of the nitroglycerin mass weighing about 2 oz., mistaking it for ordinary chocolate. A bad headache supervened, necessitating his lying down, but he was at work again on the following day."

The "mass" in question is composed of nitroglycerin with chocolate in the proportion of 1/100 grain in 2½ grains; the amount of nitroglycerin consumed therefore by the predatory individual on that occasion was approximately 3½ grains.

May I add that the young man was a German apprentice of mine, and that his exclamations in half-broken English, to the effect, "Mein Gott, I shall die, I shall die!" as he gavotted round the laboratory waving his arms about, were the cause of some mirth to bystanders. As things have turned out he possibly *has* died by now from the effects of nitroglycerin employed in another way.

Considering the powerful vasodilator action of this and allied drugs (the late Prof. Leech determined that the circulation is distinctly affected by even 1/1000 grain of nitroglycerin), it is of interest to realise to what a remarkable extent they are tolerated. Single doses of 5 grains and daily doses of 20 grains have been administered medicinally with safety, according to the *Brit. Med. Jl.*, Epitome ii., 1905, p. 52. Has any one of your readers any knowledge of higher amounts having been taken?

W. H. MARTINDALE.

10 New Cavendish Street, London, W.

MR. MARTINDALE'S extremely interesting letter supplies the clue as to how anyone could mistake nitroglycerin for chocolate, but as the book referred to gives no reference and omits the word "mass" after nitroglycerin, the ordinary reader will gain a somewhat confused idea as to the toxic action and characteristics of nitroglycerin. THE REVIEWER.

The Principle of Similitude.

IN NATURE of March 18, Lord Rayleigh gives this formula, $h=\kappa a\theta.\mathrm{F}(avc/\kappa)$, considering heat, temperature, length, and time as four "independent" units. If we suppose that only three of these quantities are "really independent," we obtain a different result. For example, if the temperature is defined as the mean kinetic energy of the molecules, the principle of similitude allows us only to affirm that $h=\kappa a\theta.\mathrm{F}(v/\kappa a^2, ca^3)$.

D. RIABOUCHINSKY.

Aerodynamic Institute, Koutchino.

Structure of Hailstones.

WITH reference to the particularly violent hailstorm which passed over S.E. London on Saturday afternoon, July 24, I observed at Woolwich that the hailstones, apart from being very large, had a common shape and structure which may perhaps be worth recording. All the stones examined were either oval or pear-shaped, but not of uniform size; the broad half consisted of clear ice, while the other half was uniformly opaque or closely stratified with alternate layers of clear and opaque ice. S. L. ELBORNE.

77 West Park, Eltham, S.E., July 26.

COTTON AS A HIGH EXPLOSIVE.

AT the recent meeting of the Society of Chemical Industry held at Manchester, Mr. W. F. Reid is reported to have made the statement that nitrated cotton is not a high explosive, though every chemist knows that it is the typical high explosive. The fact that certain newspaper writers have differentiated between nitrated cotton and nitrated benzene or toluene, or any other coal-tar derivative, has nothing to do with the differentiation of a high explosive (which is of itself nitrated, and contains within itself sufficient oxygen to allow of its explosion) and those mechanical mixtures, such as gunpowder, which have been now superseded. A letter from Sir William Ramsay published in the *Times* of July 19 makes all these matters perfectly plain, and no responsible person would dispute them. I was present in the House of Lords when Lord Charnwood brought his statement before that House, and I also heard the rest of the debate, including the answer of the Marquess of Crewe. The House, consisting of those who are necessarily laymen so far as their chemical knowledge is concerned, found some difficulty in following the arguments as to whether any substitute for cotton could be effectively used.

To the chemist the matter is perfectly plain, and it has been stated with some degree of precision in an article which appeared in NATURE of July 1. It is true, and has been admitted from the very start of what is now known as the "Cotton Campaign," that some form of nitrated cellulose can be made from anything which contains cellulose. There is not the slightest difference of scientific opinion on this matter, and every competent chemist will concur with what I say, but in practical matters things stand on a totally different footing. There must not only be a regularity of the supply of material, but there must be uniformity of quality; and, in the article already referred to, this point has been made tolerably

clear. It is by no means taking too high a position to state that, unless such uniformity is certain, the task of any works' manager will be so heavy and the risks which he will encounter so great that his factory will be endangered. Quite apart from this, even supposing he surmounts such obstacles, the material which he will produce will be markedly inferior to that which he can make in the ordinary course of his business. It has been quite rightly pointed out by people of expert knowledge and authority that the ballistics on which artillerists' calculations are based are demolished by any alteration in his charge. Sir William Ramsay is perfectly right in showing, not only that the pointing and therefore the sighting of the gun must be altered, but also that the chamber in which the explosive is fired must be enlarged if any form of nitro-cotton inferior to the standard material is used; and it is quite conceivable that the weight of the projectile and the pitch of the grooving would also have to be changed. Without going too closely into such highly technical matters, it can be said with full confidence that the gunner would have his trade to learn again, and this can scarcely be done in the midst of a war.

Many references have been made to the use of substitutes for cotton in the manufacture of nitro-cellulose, but they are all of a somewhat academic kind. As has been stated above, no one doubts that such things can be used, but it is a sort of misapplied ingenuity which seeks to find sources of cellulosic materials; such ingenuity would be quite thrown away on a practical maker. There is one possible danger, due entirely to the laxity of the control of the import of cotton at the beginning of the war; it is that between August 4 and the present date the German chemists have been sedulously endeavouring to utilise some such materials. Eleven months, now nearly twelve, is enough even for a German chemist to make some progress; and it may be that a nitro-cellulose of a sort may be being made in Germany now from material other than cotton. The fact remains, however, that the Germans are eagerly buying cotton, and are doing their utmost to obtain more than their legitimate share of the new crop which should be on the market in a month or two.

There is much truth in the statements which have been made in many periodicals—in the *Times* on several occasions and in the *Engineer* a good many months ago—to the effect that we English people have been a little too modest. Because of the great flood of genius which governed the German nation somewhere in the middle of the last century, and gave us those deathless names, Bunsen, Kekulé, Liebig, Meyer, and others, and because some of our present chemists of the highest rank were trained under these great men, the ordinary British public has been obsessed with the idea that chemistry is a German science. A very little knowledge of the history of chemistry would show that such a mistake is almost childish. Our French friends have claimed that chemistry is a French science, but those of us who have read the work of Robert Boyle or have studied the work of Priestley, Cavendish, Berzelius, know very well that chemistry is cosmopolitan. The arrogance of German soldiers has been reflected in a similar arrogance of German chemists; and those eminent in our land whose names it would be impertinent to recite, as well as such of our colleagues now living, whether Scandinavian or Dutch, to whom again it would be improper to refer, have their own opinion as to the correctness of any claim by German chemists to a prerogative in science.

To return to the question of cotton, I think there is not the slightest doubt among those whose opinion is of value that raw cotton or cotton waste is absolutely essential for the production of a satisfactory propulsive explosive; and this view has been accepted by responsible statesmen in both Houses. Personally, investigations of this question through commercial channels have convinced me that this is a fact, and I am perfectly prepared to maintain it against anyone who claims an equal authority.

BERTRAM BLOUNT.

THE WAR AND CHEMICAL INDUSTRY.

ON the occasion of the annual meeting of the Society of Chemical Industry, of which an account appeared in NATURE of July 22, there was a notable change in the character of its business as compared with that of previous annual gatherings. We learn from Prof. Henderson's presidential address that, in the opinion of the society's council, too much of the time over which the meeting extends had hitherto been devoted to purely social functions, and that in the past no sufficient advantage had been taken of the opportunity afforded by such an assemblage of technologists to lecture them on matters which superior persons might hold to be for their general good. No doubt the council, like the rest of us, is impressed with the seriousness of the strenuous and critical times in which we are living. Whatever semblance of frivolity may have hitherto characterised these annual gatherings obviously would be out of place on the present occasion. Accordingly, with the co-operation of the Manchester section, a special programme was arranged which should at once be "topical" and illustrative of the good resolutions of the council.

Whether their hopes and wishes have been wholly realised may be open to doubt. Four special papers, in addition to the president's address, were presented for the consideration of the members. Naturally, since so much has been said during the past ten or eleven months concerning the relations, immediate and proximate, of applied chemistry to the war, and to matters arising, directly or indirectly, out of it, it was almost inevitable that this comprehensive subject should be the dominant feature of the communications. Prof. Henderson, as might be expected, could not refrain from some reference to a feeling of disappointment that fuller use had not been

made of the society's desire to be of national service. It is regrettable on all grounds that the scientific resources of the nation have not been systematically utilised by the Government. Some help, he admitted, has been rendered, but more, he thought, might have been done by a more efficient organisation—say, by the creation of a "central body" which should have the duty on the one hand of keeping in intimate touch with the Admiralty, the War Office, and the Ministry for Munitions, and on the other of referring to the societies representative of the different branches of pure and applied science the questions with which each is particularly fitted to deal. How far this conception of a scientific clearing-house differs essentially from that which has actually been set up by the Royal Society is not, however, very clear.

Naturally, too, Prof. Henderson bemoans our backsliding as regards the position and future prospects of our chemical industries:—

We have been made to realise more clearly than ever before that during the last forty years chemical industry in Germany has made marvellous strides in advance, whilst in this country it has by comparison stood still or even gone back. We have to admit that certain branches of applied chemistry, particularly the manufacture of dyestuffs, of synthetic drugs, and of organic compounds and fine chemicals in general, have passed almost wholly out of our hands, or rather have never been taken up to any notable extent in this country.

As to the real reasons for German progress and British backwardness there is little doubt, in Prof. Henderson's mind. He shares the conviction of Profs. Perkin and Meldola that it is due partly to our failure to realise that "scientific research work, carried out in the laboratory, is the soul of industrial prosperity," and partly to the mutual aloofness and reserve of manufacturers and teachers. But, whatever may be the true causes, Prof. Henderson is emphatically of the opinion of most sensible men that it is about time "we cut the cackle and came to the 'osses"—or, as he prefers to put it, "that we shall refrain from talk and proceed to action." "Let us admit frankly that we have left undone many things which we ought to have done, and, having confessed our sins, let us unite in striving to secure the future prosperity of our industries."

We might well apply this injunction to certain papers which followed the president's address. Of them it may be said they were *Vox, et praeterea nihil*. The author of one paper bewails our proneness to label-worshipping, and the "stupid confusion" which paralyses "a bewildered public" in its efforts to distinguish the chemist, properly although not legally so called, from the pharmacist or apothecary. He tilts against the system under which our schools and colleges are governed, considers that teachers are "victimised by the principle of the hole-and-corner," and is of opinion that appointments should be made by the candidates making the selection themselves.

Another author tilts against everybody and everything in general—whatever is, is *wrong*, is the refrain of his paper—English education and English life, the British public, the Board of Trade and the War Office, the Home Office, the Local Government Board in particular, the Government of course, collectively; lawyer-politicians as a class, with special reference to the late Lord Chancellor and Lord Moulton of Bank for interfering in matters with which they had no concern; Oxford and the Royal Society and the general body of men of science—all alike come in for cavil, censure, and condemnation. Even the society he was addressing "needs to wake up." It "must intervene actively in the promotion and protection of chemical industry." In spite of what others regard as more than thirty years of creditable activity, the members were told it has been "almost supine hitherto," and has "allowed others to tinker with matters" which primarily should be its concern. No doubt the somnolent members, when they did wake up, rubbed their eyes in hopeless wonderment as to who had been poaching upon their preserves. But they were probably reassured when they learned that it was only the deputation, "nominally representing the Royal and Chemical Societies"—"academic parties in science" and "first cousins to the lawyer-politicians"—who recently waited upon the Presidents of the Boards of Trade and Education, and so presumably they went comfortably to sleep again.

It is one of our national characteristics that we rather enjoy self-depreciation, and that we have a good-humoured toleration of the critic who reminds us of our national shortcomings. But something depends upon how it is done. The implied reproof, to begin with, must be intrinsically just and merited. If it is so recognised, it adds to its effectiveness when administered with a certain delicacy and restraint of statement. But no useful purpose is served by reckless assertion and indiscriminate blame, declaimed in an exuberant philippic.

It is a relief to turn to the paper by Dr. Beilby on chemical engineering, and to that by Sir W. H. Lever on copartnership in chemical industries; for it is papers like these that are of real use to us at the present juncture. According to Dr. Beilby our "colleges have two distinct functions to perform, and it is best that this should be clearly recognised; first, to allow the future leaders in applied science to come naturally to the top during their training; and secondly, to prepare a large number of well-trained professional men for the organisation and development of industry." He fears that the making of practical chemists has suffered severely from the fallacy that all students ought to aim at being pioneers in some branch of their science. "Science and industry alike call aloud for *real pioneers*, for without these the highest type of progress cannot be realised. This call, however, cannot be met by the premature stimulation of 'originality' in men of very ordinary endowment. The effect of this stimulation is not merely

futile, it is positively mischievous, for it raises an ideal which for the ordinary man is quite inappropriate during his preparation for a life of serious practical endeavour." The remarkable development of chemical industry in Germany has resulted much more from the large command of chemists and engineers of sound professional training and ability than from the possession also of an even larger supply of research chemists of mediocre ability.

Sir William Lever's paper is a weighty contribution to what is at the present crisis a very serious problem. One of the most distressing features of the times is the widespread unrest in the labour world concerning the division of the profits arising from the remarkable activity of certain industries connected with the war. So far it has not extended to any marked extent to the chemical industries, probably because these are not subjected to the same disturbing influences as, say, the coal-miners. But Sir William Lever's paper is a timely account, judicious, impartial, and dispassionate, of the working of a system which is pursued with signal advantage and success in the great organisation which he controls, and as such it may be commended to the thoughtful consideration of all employers of labour.

THE ROYAL GEOGRAPHICAL SOCIETY'S WORK ON THE ONE-MILLION MAP.

MR. A. R. HINKS, secretary of the Royal Geographical Society, described at a recent meeting of the society the work which has been carried out, and is still in progress, on a map on the scale 1/1,000,000. It is well known that, before the outbreak of war, conferences of representatives of the principal Powers had met in London and Paris, and had come to an agreement as to the production of a map on this scale, to cover ultimately all lands, on a uniform projection and with uniform methods of representation, etc. A few sheets had been produced in various countries. They were scattered, in some instances imperfect and not available in any quantity, and in any event useless to meet even partially the necessity which was felt, almost at the outset of the war, of a map to cover uniformly Western and Central Europe and Asia Minor and adjacent areas affected by military operations. Even for Europe no such map existed, and it was necessary, in taking a broad view of the operations, or for any such purpose as that which will ultimately become of prime importance, the tracing of boundaries, to pass at certain points from maps of a particular scale and method to others totally different in every respect. People are prone to comment that the scale 1/1,000,000 (nearly 16 miles = 1 inch) is too small even for such general purposes, but it is not so. It allows the representation of important places, railways, roads and boundaries, rivers, and elevation by means of contour lines, either alone or in conjunction with layer colours.

Such a map, then, was undertaken by the Royal Geographical Society under the direction of the Geographical Section of the General Staff. The society's responsibility has extended to the compilation of construction drawings from the materials available on the spot, while the engraving and reproduction is being carried out by the Ordnance Survey Department. Methods have been used which, if slightly rough, have allowed of high speed, and a number of the sheets are already on the market in a preliminary issue. The work at the society's house has been done by Mr. Hinks and a number of volunteer fellows, all more or less accustomed to map-compilation, with the assistance of certain external advisers and a few trained draughtsmen.

Despite the possibilities for error which are inseparable from work done thus rapidly and without access to local information at the moment —possibilities which were frankly discussed by Mr. Hinks—there can be no question that a valuable and important task has been accomplished. Much experience has been gained. In certain respects the methods laid down at the international conferences have been improved upon. Two of the most important departments in which the work marks a real scientific advance are (1) the solid endeavours which have been made to overcome the immense difficulties of regularising the spelling of place-names in Central and Near Eastern Europe; (2) the contouring of the maps, which, in the same localities, often represents a reasoned collation of very imperfect sources, and the application to the data thus obtained of what may be called topographical sentiment of a high order. The systems of transliteration and hints as to pronunciation are indicated, where necessary, on the maps themselves. The work of compiling the physical outlines and contours has enabled a proper value to be set on many of the well-known official and other maps; notably it has resulted in the detailed criticism of the great Austrian staff map of 1/750,000, which does not emerge triumphantly from this test.

It is to be hoped that on the solid foundation of preliminary work thus laid will be raised, after present exigencies have been met, a structure of permanent value to geography generally; these maps should ultimately be revised and executed by the best methods, excellent as the present results are for the time being.

RECENT STUDIES IN THE DYNAMICS OF LIVING MATTER.

THERE is no falling off in the stream of work which comes from Prof. Jacques Loeb's laboratory in the Rockefeller Institute, from which we have now before us some ten or a dozen papers, mostly by Prof. Loeb himself, all published since the beginning of last year. They deal with various subjects in that field of comparative physiology, or dynamical biology, which Loeb has so diligently reaped as well as sown. Most of them are concerned with one or other of three topics, the phenomenon of heliotropism, the in-

exhaustible problem of growth, and, lastly, the conditions which determine or which prevent the entrance of the spermatozoon into the egg.

In Prof. Loeb's book, which bears the title set at the head of this short article, there is a well-known chapter on heliotropism, that is to say on the tendency of plants to turn towards the light, and on other kindred phenomena manifested both in plants and animals; for the polypes of a hydroid colony such as Eudendrium, or the tube-dwelling worms such as Serpula or Spirographis, also bend towards the light, and if they be illuminated by a single beam they grow steadily in the direction of its rays. It is characteristic of the plant (or rather of the green plant) that it represents a peculiar type of machine which is capable of turning radiant energy into chemical energy, and so ultimately into mechanical work; and in the case of the plant, "the permanency of this kind of machine is guaranteed by the presence of an automatic arrangement, whereby their stems turn towards the light." So Loeb is inclined to read into this phenomenon what we might call a modified teleology, such indeed as, in one form or another, refuses to be kept out even of our most modern biological speculations.

In the chapter already alluded to, published some nine years ago, our knowledge was said to be very scanty as to the relative heliotropic efficiency of the various parts of the spectrum, little more being known than that the more refractive rays, the green, the blue, and the violet, were more effective than the yellow and the red. "There exists thus, apparently," said Prof. Loeb, "a division of labour, the longer light-waves accelerating assimilation, and the shorter waves accelerating heliotropism;"—just (we might say) as there is obviously a "division of labour" between the rays which illuminate and those which warm us.

Two of Prof. Loeb's recent papers (by Dr. H. Wasteneys and himself) (Pr. Nat. Acad. of Science, January, 1915, and *Science*, February 26, 1915) are devoted to the question of the identity of heliotropism in plants and animals, and thereby to an inquiry into the particular wave-lengths of light to which, in one case or another, they are most sensitive. Instead of exposing the organisms to the solar spectrum itself, as had been done in earlier and simpler experiments, the writers (using a carbon arc spectrum) allowed the light from particular portions of it to pass through narrow slits, and then reflected it in a monochromatic beam upon the subject of their experiments. They soon arrived at the simple but very remarkable result that there are two particular regions of the spectrum the rays of which are especially effective in causing organisms to turn, or to congregate, towards them; these regions lie (1) in the blue, in the neighbourhood of a wave-length of 477 $\mu\mu$, and (2) in the yellowish-green, in the region of $\lambda=534$ $\mu\mu$; and these two wave-lengths affect different organisms, with no very evident relation to the nature of these latter. Thus the blue rays (of 477 $\mu\mu$) attract the infusorian Euglena, the hydroid Eudendrium, and the seedlings of oats; while the yellowish-green rays (of 534 $\mu\mu$) in turn affect the protozoon Chlamydomonas, the little water-flea Daphnia, and the larvæ of barnacles.

These facts add a quality of precision to many older and vaguer observations, for instance, to Paul Bert's discovery (in 1869) that Daphnia swims towards the light in all parts of the visible spectrum, but most rapidly in the yellow or the green. The particular wave-length of 534 $\mu\mu$ is especially remarkable, because it coincides with a determination by Trendelenberg that the visual purple of the rabbit's eye (which is not affected by red and very little by yellow light) is bleached most rapidly by light the wave-length of which is 536 $\mu\mu$. It would seem, according to Loeb, that among the lower organisms we have to deal with two separate photosensitive substances, which determine their heliotropic reactions; that these are distributed without regard to the systematic boundaries, even between plants and animals; and that one of the two, occurring even among very lowly organisms, has characters similar to, and is perhaps identical with, the visual purple of the highest type of eye.

In another paper (*Science*, November 6, 1914), still dealing with the effects of light, Prof. Loeb relates some remarkable observations on the action of ultra-violet rays upon unfertilised eggs, adding by these new experiments a curious detail to the many facts regarding artificial fertilisation, by chemical or physical means, which we associate with his name as their prime discoverer. On the ground that ultra-violet rays are known to have a sterilising effect, that is to say to be capable agents in the destruction of cell-life, and that, according to Loeb's own experiments, the very substances which induce "cytolysis" in the living cell are also capable (under proper conditions) of producing artificial parthenogenesis, Loeb thought it likely that these rays would also prove to be effective stimuli, under the appropriate conditions, of parthenogenetic development. He exposed the unfertilised eggs of a sea-urchin for ten minutes to the light of a quartz mercury arc lamp, and found that the majority of the eggs formed "fertilisation membranes"; when kept cool they further proceeded to segment, but ere long perished; an addition of hypertonic sea-water, however, enabled them to develop into larvæ, though few advanced beyond the gastrula stage. It was remarkable that a cover-glass, 0·1 mm. thick, was sufficient to prevent all action on the part of the light, a fact which bears closely on the wave-length of the rays which produced the action.

The discovery here mentioned is certainly interesting as a specific case of the effect of radiant energy on living protoplasm; but its precise degree of interest turns largely on the importance which we may attach to the formation of a surface-membrane as an essential preliminary to the development of the egg. According to Loeb this phenomenon is of supreme importance; for the question why an unfertilised egg cannot grow, and why a fertilised egg can grow and divide, depends, according to

him, entirely on the condition of the surface layer of the egg; the nature of this cortical layer determines whether the egg be in an active or a passive phase, and the essential factor is a change in the rate of oxidation, to which the condition of the cortical layer directly leads. "The forces which induce the egg to develop are, therefore, localised *at the surface of the cell.*" This is a somewhat hard saying, but in Prof. Loeb's hands it leads to many suggestive and stimulating reflections. The whole subject is discussed in his book on "Artificial Parthenogenesis, etc." (1913), and in a paper now before us, on the Stimulation of Growth (*Science*, May 14, 1915).

D'ARCY W. THOMPSON.

SIR SANDFORD FLEMING.

THE death of Sir Sandford Fleming on July 22nd at eighty-eight years of age has deprived the world not only of one of its greatest engineers, whose constructive works revolutionised trade and commerce by providing increased facilities for intercouse, but also of one who in various ways proved himself a pioneer, advocating and supporting measures the importance of which had not yet penetrated the public mind. He will be longest remembered for his work on the Canadian Pacific Railway and for his successful advocacy of a cable across the Pacific, which has proved of so much value to the commercial world. But in smaller matters he exerted himself not less strenuously and usefully. In a new country where material interests are many and pressing, he early saw the necessity of upholding pure science for the encouragement it could give to arts and industry, and with this view, so far back as 1849, he promoted the foundation of the Canadian Institute, which after demonstrating its usefulness in various directions, was recently incorporated under a Royal Charter.

Not less farseeing and useful was Sir Sandford Fleming's proposal in 1879 to legalise a universal day, beginning at mean noon of Greenwich time, the hours being counted continuously from 0 h. to 24 h. Five years later this suggestion bore fruit at the conference at Washington, summoned to consider more uniform methods of reckoning time, and at which it was resolved to adopt a single prime meridian for all nations in place of the initial meridians, favoured as this mode of reckoning was by international jealousies. At this conference Sir Sandford Fleming represented Canada, and it was there that the zone system of reckoning with which his name has been intimately connected was first ventilated. The convenience of adopting a standard time differing by an exact number of hours from universal time was insisted upon, and it was shown that it was not necessary, as maintained at a previous conference at Rome, to retain exact local time side by side with universal time. We have not yet achieved the arduous task of counting the hours consecutively from 0 to 24 h. as recommended, but the method is so eminently desirable in civil affairs as being thoroughly explicit and rendering unnecessary the distinguishing suffix a.m. or p.m., that we may hope the practical advantages will become apparent to the public as they were to the eminent engineer whose death we regretfully record.

NOTES.

THE Société Helvétique des Sciences Naturelles will hold, at Geneva, on September 12–15, its ninety-seventh annual session, which will coincide with the hundredth anniversary of its foundation. On account of the disturbed conditions existing at the present time, the council of the society has decided to celebrate this anniversary very quietly, and not to send the usual invitations to foreign scientific societies, or to men of science residing outside Switzerland.

THE Toronto correspondent of the *Times* announces that the Commission appointed by the Ontario Government to investigate the production and shipment of nickel in relation to the conditions created by the war consists of Mr. G. T. Holloway, of London (chairman); Prof. W. G. Miller, provincial geologist; Mr. McGregor Young, K.C., Toronto; and Mr. T. W. Gibson, Deputy-Minister of Mines. It is undersfood that in the course of its investigation the Commission will visit England and Norway and the New Caledonia mines in the South Seas. The Commission will also consider if nickel can be successfully refined in Canada. The importance of nickel as a munition metal was described by Prof. Carpenter in an article in NATURE of July 15 (p. 539).

A NOTABLE instance of the advantage to the State of calling in the aid of science in relation to difficult problems bearing directly on the well-being of our fighting forces is illustrated in the exhibit recently installed in the central hall of the Natural History Museum showing the work done in connection with an investigation undertaken jointly by the War Office and the Museum to determine the origin of damage to army biscuit by insect pests, and to prevent or minimise such infestation. Attention was directed to the matter some time ago by the fact that ration biscuits exported to the colonies became after a time quite unfit for consumption, owing to the ravages of certain moths and beetles—this was specially noted in South Africa, Ceylon, Gibraltar, Malta, Mauritius, and the Sudan. In answer to an application from the War Office, the trustees of the British Museum placed at the disposal of the military authorities for the purpose of the inquiry the services of Mr. J. Hartley Durrant, the expert in charge of the collection of microlepidoptera at South Kensington. It is most satisfactory to learn that these researches, which have been carried out jointly by the two departments concerned, extending over a period of three years, have ensured the protection of army biscuit from the possibility of such attacks by insects in the future. The insects met with during the inquiry were all widely distributed species the range of which has doubtless been greatly extended by commerce.

PROF. A. ARNAUD, whose death will be deplored by chemists and pharmacologists, had made a world-wide reputation by his researches on ouabain, strophanthin, digitalin, cupreine, etc. For nearly a quarter of a century Prof. Arnaud occupied the chair of chemistry at the Museum of Natural History in Paris, and the numerous researches that he published have made his name familiar to the chemists and pharmacologists of all countries. By his death science has lost one of its most able exponents.

IT is with regret that we record the death of F. P. J. Guéguen, late professor of botany in the School of Agriculture at Grignon. Prof. Guéguen was born at Loudéac, in Brittany, in 1872, and, having trained at the Ecole Supérieure de Pharmacie, became a hospital pharmacist in 1895. In 1899 he gained the title of doctor of pharmacy, his thesis being an account of researches on the mycelia present in pharmaceutical solutions. He afterwards devoted himself chiefly to cryptogamic botany, became assistant professor in the Ecole de Pharmacie in 1904, and for the last few years of his life occupied the chair of botany in the School of Agriculture at Grignon. Prof. Guéguen published numerous papers dealing chiefly with cryptogamic botany.

THE death of Sir James Murray, on July 26, removes a well-known figure from Oxford society. For more than thirty years his face and form had been among the most familiar sights in the University. His courteous manners and address, and his air of grave distinction, attracted the notice even of strangers, but to those who knew him intimately he was one of the most delightful of associates. Learned, but no pedant, keenly interested in all departments of mental activity, possessed of a wide acquaintance with science and literature, and equipped with knowledge, probably unequalled, of his own special branch of inquiry, he was always ready to impart information from the immense stores of his erudition. He had the gift of interesting others in his own subject without forcing it upon them or wearying them with over-minute details. His enthusiasm in his great work of the New English Dictionary, though evident to all who knew him, was held within due bounds by a plentiful endowment of common sense and a certain good-humoured shrewdness of nature, which was no doubt attributable to his northern origin. His conscientiousness was extreme. He spared no pains in ensuring the utmost accuracy of definition for the technical terms in the dictionary, taking every opportunity of consulting those best qualified to advise on such subjects. But he was no mere compiler, and his own mathematical and scientific knowledge was employed with excellent results. Though in his bearing the pink of courtesy, he could be trenchant in literary or philological criticism. Amusing stories have been current of the way in which some of his comments on other lexicographers have been toned down for publication by his assistants. His death at the age of seventy-eight has disappointed the hopes of those who looked forward to see him finish the great work now so near completion.

BY the death of Dr. Alexander Stewart, principal of St. Mary's College, St. Andrews, which occurred somewhat suddenly on July 21, science has lost a genial friend and supporter, who, throughout his twenty-one years of office as principal, was ever ready in a quiet and judicious way to champion her cause. As an old and distinguished student of St. Andrews, for he was first bursar in 1864, and, later, Lord Rector's prizeman, and a graduate of the University, he took a deep interest in all the modern developments of the museum, the marine laboratory, and the lectureships of botany and geology, the latter specially owing much to his fostering care. Moreover, though he did not, like his talented predecessor, Dr. John Cunningham, profess to study divinity scientifically, yet he took a broad and modern view of his subject, and by his erudition, fine voice, and great lucidity of expression, was ever a popular lecturer and preacher. His first appointment was to the parish of Mains and Strathmartine, near Dundee; his second to the chair of systematic theology in Aberdeen University; and his third to the principalship of St. Mary's College, St. Andrews. He was moderator of the General Assembly of the Church of Scotland in 1911, the year in which the five hundredth anniversary of his own University was celebrated, but after installation in the moderatorship he caught a chill, so that he was only able to appear on the closing day. He exerted himself, however, to fulfil all the other onerous duties during his year of office. In his early days he was an active gymnast and student-president of the University Club, in the welfare of which, as in that of the old University Battery and modern O.T.C., he took a deep interest to the last. As a colleague he gained the esteem of all from his straightforward, genial, and considerate character. His broad sympathies with science and his unselfish and modest bearing won for him the respect alike of colleague and student, as well as gave him a wide circle of scientific friends who mourn his loss.

IN the article upon "The Evolution of the Goniometer," which appeared in NATURE of July 22, it was no part of the historical sketch to give a systematic list of the instrument-makers who had constructed the several types, but since, as Mr. Conrad Beck has pointed out to us, it might appear as if British instrument-makers had not borne their share, we think it right to remove any such misapprehension. Messrs. Troughton and Simms have constructed many fine instruments for, among others, Sir Henry Miers, Dr. A. E. H. Tutton, and the British Museum, and Dr. Hutchinson's universal goniometer, which was described and illustrated in the article, is made by Messrs. James Swift and Son, who kindly lent the block to illustrate the article. In the goniometer, as in all classes of instruments, British manufacurers stand second to none in excellence of workmanship; it is no fault of theirs that owing to the comparative neglect of the study of crystallography in this country they have found so little demand for crystal-measuring apparatus.

IN continuation of the register published in NATURE of July 15 and 22 we are informed that the following

members of scientific staffs are on active service with H.M. Forces:—*Plymouth: Marine Biological Association's Laboratory*:—L. R. Crawshay, naturalist, Lance-Corpl. 1st King Edward's Horse; E. W. Nelson, naturalist, Lieut.-Commander, Royal Naval Division; J. H. Orton, naturalist, 2nd Lieut. Royal Garrison Artillery; E. Ford, assistant naturalist, 2nd Lieut. 4/2 London Royal Fusiliers. *Kingston, Derby: Midland Agricultural and Dairy College*:—J. H. Beale, lecturer in horticulture, Lance-Corpl, 2/7th Batt. Sherwood Foresters; F. Knowles, soil analyst, private, 2/7th Batt. Sherwood Foresters; H. M. McCreath, assistant lecturer in agriculture, 2nd Lieut. 8th Royal Scots Fusiliers; J. G. W. Stafford, assistant lecturer in dairying, 2nd Lieut. 11th West Riding Regiment; J. C. Wallace, lecturer in horticulture, Corpl. motor despatch rider, Cavalry Corps, Expeditionary Force.

THE *Cambridge University Reporter* of July 13 publishes the report of the Antiquarian Committee for 1914. In spite of some delay caused by trade disputes, good progress has been made in the erection of the second section of block ii. of the new museum. The divisions of the building will be named after generous benefactors: Messrs. C. E. Keyser, C. C. Babington, and A. A. Bevan. Other donors have provided funds for the fittings of the new building, but the lack of showcases still retards the work of arrangement, and it is difficult to prevent damage to specimens stored away in boxes. A long list of accessions to the collection is given, and the master and fellows of Trinity College are thanked for permitting the transfer on deposit of all the ethnological and antiquarian specimens which had accumulated in the college library. There is still ample opportunity for other benefactors to contribute to this laudable undertaking.

PREHISTORIC cultural centres in the West Indies forms the subject of a brief essay in the Journal of the Washington Academy of Sciences for June. Remarking that the American Indian did not reach America until he had arrived at the Neolithic stage of culture, and did not make acquaintance with the use of metals until introduced after the discovery of America by Columbus, he goes on to point out that as a conseqence of this prolonged use of stone they attained to a higher standard of excellence in the use of this material, both in the fashioning of tools and architecture, than was ever attained by the Neolithic peoples of the Old World. In discussing the remains left by the aboriginal inhabitants of the West Indies he insists that three cultural epochs must be recognised—the cave-dwellers, the agriculturists, and the Caribs. The most primitive of these is found represented by objects found in the floors of caves or in the numerous shell-heaps scattered from Cuba to Trinidad. But the Caribs seem to have been preceded everywhere by the Arawaks, as is shown by the fact that pottery of high excellence has been found on all the islands inhabited by Caribs who, being a nomadic people, had not acquired this art.

THE Journal of the Royal Microscopical Society for June (part 3) contains the presidential address by Prof. G. Sims Woodhead on "Some of the Micro-biological Problems of the Present War." Prof. Woodhead discusses the question of antiseptic versus aseptic surgery, and is convinced that for the treatment of wounds received on the battlefield antiseptics should be used. The sterilisation of water by means of chlorine and causation of cerebro-spinal fever are other subjects dealt with in this interesting address.

THE lately issued report, No. 3, of the Danish Oceanographical Expeditions, 1908-10, is mainly occupied by K. Stephensen's account of the Isopoda, Tanaidacea, Cumacea, and Amphipoda, many of the species being illustrated by clear outline drawings. P. Jespersen's paper on deep-sea fishes of the family Sternoptychidæ is noteworthy for its detailed distributional maps. Madame P. Lemoine describes the Calcareous Algæ, illustrating her work with structural figures and a well-printed photographic plate.

AT a meeting of the council of the Ray Society, held on July 22, Prof. E. B. Poulton, vice-president, in the chair, it was resolved to issue for 1916 the second volume of Mr. W. C. Worsdell's "Plant-Teratology," comprising the flower, with twenty-seven plates, several being coloured, and about ninety text-figures, completing the work; and also the second part of vol. iii. of Prof. McIntosh's "British Marine Annelids," consisting of twenty-eight plates with descriptions, six uncoloured plates being substituted temporarily for coloured plates, which cannot at present be obtained on account of the war.

A LARGE number of the Annals of the South African Museum (vol. xiii., part 4), published in April, is filled with a paper by Mr. M. Connolly, on South African Mollusca, which he modestly entitles "Notes." The most important of these is a mongraph of the Dorcasiinæ—a distinctively tropical and South African subfamily of snails, which are fully described, with anatomical details, and a suggestive distributional discussion in which the author supports the theory of an ancient tropical continental tract stretching from South America by Africa and the Indian Ocean to Australia.

THE last number (vol. xii., No. 76) of the Quekett Microscopical Club's Journal contains an account by Mr. R. T. Lewis of the early history of the club, which, founded on July 7th, 1865, has just celebrated its fiftieth birthday. Its first president was Dr. E. Lankester, and among his successors may be mentioned T. H. Huxley, W. B. Carpenter, A. D. Michael, and B. T. Lowne. Prof. A. Dendy now occupies the chair of the club, and his suggestive address on the biological conception of individuality is printed in the same number. The complexity and difficulty of the subject is well illustrated by his references to the well-known "border" cases of the Siphonophora, Cestoda, Annelida, and the communities of social insects, as well as to abnormal instances of "double personality" in human beings.

WE have received the first number of vol. ix. of the *Quarterly Journal of Experimental Physiology*. It scarcely seems that it is as much as eight years ago

that Sir Edward Schäfer founded this new physiological journal, and we wished it good-speed. The publication retains the high standard insisted upon by its editor, and the present number, among the interesting papers which it contains, is specially noteworthy as showing the activity of physiological laboratories in British dominions beyond the seas. One of these comes from Winnipeg, and deals with vasomotor reflexes (by Prof. Swale Vincent and Dr. A. T. Cameron); the other is by Prof. Jolly, of the South African College, Cape Town, and treats of the electro-cardiogram; in his attempt to unravel the meaning of the component parts of the curve he makes the interesting suggestion, and supports it by experimental arguments, that the two phases of metabolism (anabolism and katabolism) which have opposite electrical expressions are responsible for the alternating direction of the variations seen in the electro-cardiogram. Both Profs. Swale Vincent and Jolly are former assistants in Sir Edward's department at Edinburgh.

THOSE interested in the study of spiders, and of Indian spiders in particular, will welcome the first of what is intended to be a long series of "Notes on Indian Mygalomorph Spiders" in the Records of the Indian Museum, vol. xi., part 3, by the assistant superintendent of the museum, Mr. F. Gravely. The author makes stimulating comments on the Ischnocoleæ of the subfamily Avicularinæ, so well represented in the Indian Peninsula, since from their many primitive characters they afford an insight into many evolutionary problems which yet await investigation. The Indian genera of this group seem to present a marked sexual dimorphism, all the known males being distinguished by the more or less extensive and conspicuous development of white hair on the feet, especially the anterior ones. His views on nomenclature and certain aspects of systematics seem to be yet in a state of flux.

ALL who are in any way concerned with the problems of economic ornithology, or of pisciculture, should read the report of Mr. P. A. Taverner on the "Double-crested Cormorant (*Phalacrocorax auritus*), and its Relation to the Salmon Industries on the Gulf of St. Lawrence," issued by the Canada Department of Mines (Biological Series No. 5, April, 1915). It is one of the most admirable summaries of its kind ever issued, and is the result of an inquiry instituted by the Geological Survey into the complaints of those interested in the salmon fisheries of the destruction caused to the fisheries by the ravages of the cormorants. The full account of a prolonged and impartial investigation is given in this bulletin, and the verdict arrived at shows conclusively that the harm attributed to this bird is absolutely without foundation. The author shows that while a small percentage of parr are undoubtedly eaten by cormorants, the bulk of the food of these birds is furnished by far less agile fish, having for the most part no economic value. The greatest enemies of young salmon, in the rivers, are older salmon, and the greatest toll on their numbers is taken during their sojourn in the sea by enemies which have yet to be determined. A precisely similar charge was levelled, some years ago, against the cormorants of the Murray River in Australia, where, to increase the salmon supply, a huge colony of cormorants was wiped out. But the unexpected happened. The salmon disappeared with the birds. It was then found that the latter had been feeding on crabs and eels, which in turn fed upon salmon eggs and fry. With the extermination of their enemies they increased in such numbers that scarcely a salmon egg remained, the fry from such as did escape were eaten by the eels. Those responsible for the massacre of the cormorants are now repentant!

In the *Philippine Journal of Science* (vol. x., Sec. C, No. 2, March, 1915) Mr. E. D. Merrill publishes the second instalment of his "Studies on Philippine Rubiaceæ." The paper consists of critical notes on the genera Mycetia, Chasalia, Psychotria, and Grumilea in particular, with descriptions of forty-two new species in various genera. The genus Pravinia, hitherto known from Borneo and Celebes with two species in each locality, is now found to be represented in Negros, Philippines, by a new species, *P. everettii*. Some ninety distinct species of the genus Psychotria are already known from the islands.

MR. Y. TOKUGAWA contributes a paper on the physiology of pollen to the Journal of the College of Science, Imperial University of Tokyo, vol. xxxv., December 17, 1914, a copy of which has just reached us. He finds that suitable osmotic pressure and suitable nourishment are essential for the growth of the pollen tube, and that cane-sugar alone is not sufficient for its growth. Among inorganic salts those of the heavy metals are more injurious than those of the lighter to the growth of the pollen. The pollen tube finds its way to the canals of the style and to the micropyle owing to the presence of a chemotropic substance. A fact of interest which is brought out is that the pollen grains of monocotyledons can germinate on the stigmas of dicotyledonous plants, and *vice versa*, though pollen grains frequently fail to germinate on the stigmas of plants nearly related to those whence the pollen was obtained.

Science for May 28 contains an interesting paper on disease resistance in plants, being a lecture delivered by Dr. Otto Appel, of Berlin, at various universities in the United States in October, 1914. The author points out that disease in plants is usually combated by killing the parasite before it enters the host, but the main theme of the lecture concerns the control of disease by breeding disease-resisting plants. As illustrations of the latter method of control, the breeding of rust-resistant wheats, the introduction of *Coffea robusta* as a plant less susceptible to attacks of *Hemileia vastatrix*, and the grafting of the European vine on resistant American stocks in dealing with Phylloxera are cited among other cases. There is no mention in the paper of the extensive work on wheats undertaken successfully by Prof. Biffen at Cambridge to produce immune varieties of wheat, nor is Dr. Appel's statement correct that rust has disappeared with the destruction of Barbery bushes, since the summer or uredo-spores have been found

capable of surviving the winter and infecting the young wheat in spring. Breeding from plants possessing mechanical or other advantages tending to prevent the attacks of fungi is, however, as Dr. Appel suggests, likely to prove one of the most fruitful methods of controlling disease in plants.

THE Journal of the Royal Horticultural Society (vol. xl., part 3) contains several useful horticultural papers, and one of particular interest on the double stock, its history and literature, by Miss E. R. Saunders. The double stock is referred to first by Dodoens in 1568, and is figured by de l'Obel in 1581. Speculations as to the origin and mode of production of double stocks have been varied and frequent, and it is only owing to the Mendelian methods of analysis that light has been thrown on the subject. It appears that there are two fundamentally distinct types of single stocks—one of which gives rise only to single stocks, and the other which yields both doubles and singles, the proportion of doubles being from 53–57 per cent. How the doubles arose from the race of singles some two hundred and fifty years ago is unknown, but the ratio of doubles to singles yielded by these singles appears to be constant for all strains. In these ever-sporting singles it has been proved that all the pollen grains and some of the ovules lack a factor which produces singleness, and by the mating of such deficient pollen grains and ovules together the double-flowered form results. It has further been found that the double-flowered seedling grows more strongly than that of the single-flowered plant.

AN official guide to the Botanic Gardens, Dominica, has recently been issued (price 6*d*.), to which we would direct the particular attention of all interested in botany and in the tropical economic products of the world. The guide consists of some forty-four pages, with a good index, a map of the gardens, and a number of interesting illustrations. The area under cultivation is now about 60 acres, and consists of the garden proper of 44 acres, with experiment grounds and nurseries. In the latter are raised the lime, cacao, mango, Para rubber, coffee, and other plants, which are supplied at cost price to the planting community, and it is here that the grafting of cacao, limes, etc., and other experiments are carried out which have made the Dominica Gardens renowned. To the botanist, however, the garden proper is the more important feature. Here may be seen a multitude of interesting and useful trees and shrubs remarkably well grown and displayed, and in the guide particulars of the various plants and notes on their economic value are given. In 1892, a year after the garden was formed, Mr. Joseph Jones was sent out from Kew, and has now been curator for thirty-three years. It is to his skill and devotion that Dominica now possesses for its size one of the finest tropical botanic gardens in the world. Mr. Jones is to be congratulated on having produced so excellent and useful a guide, which will be much appreciated.

DURING the past seven years the Canadian Government has published several reports on the peat bogs of the Dominion and the efforts it has made to develop the peat industries (*v.* Nos. 30, 71, 151, and 154). A report now before us ("Investigations of the Peat Bogs and Peat Industry of Canada, 1911–12," by A. v. Anrep; Department of Mines, Canada, No. 266, Bulletin No. 9) deals with the amount and the quality of the peat contained in nine bogs situated along the line of the River St. Lawrence in the province of Quebec. It gives surface and section-maps of the bogs, and includes a detailed examination of the quality of the peat over the whole range of the bogs, which cover an area of about 34,000 acres. The portions of the various bogs suited for the manufacture of peat-moss litter on the one hand, or peat fuel on the other, are indicated on the maps which accompany the report. The author also considers in detail the engineering and commercial problems connected with the utilisation of the peat in the case of each bog. Although the report is primarily of local interest, one cannot fail, on reading it, to be struck with the contrast between the thoroughness with which the Canadian Government is grappling with the peat question and the apathy of the Irish Government towards the same problem. Interesting statistics of the peat industries of Sweden, Denmark, Holland, and Russia are given. Apart from the fact that Russia uses from 2½ to 4 million tons of peat fuel yearly, it is of some interest, especially to Irishmen, to learn that the Holmgaard factory at Naestved, in Denmark, uses about 5000 tons of peat briquettes yearly in the manufacture of glass.

THE Royal Observatory at Hong-Kong has issued its report for 1914, dealing with meteorological, magnetic, and time observations. The principal features of the weather during the year are said to be the absence of violent typhoon winds, the relatively high temperature in January, February, and March, and excessive rains in July, September, and November, with a relatively dry August, and a rainless January. The highest temperature was 94° on August 31, compared with 97° for the previous thirty-one years, and the lowest temperature was 47° on January 1, compared with 32° in previous records. July was by far the wettest month, with a rainfall of 26·31 in., and the total for the year was 100·22 in. The greatest wind velocity for any hour was forty-two miles on September 3, and the greatest squall velocity on the same day was at the rate of forty-eight miles an hour. A map of the Far East and the Daily Weather Report is regularly issued, containing observations from about forty stations in China, Indo-China, Japan, and the Philippines. A daily weather forecast is also given for Hong-Kong and district, the Formosa Channel, the south coast of China between Hong-Kong and Hainan, and the south coast of China between Hong-Kong and Lamocks.

THE recently published *Compte rendu* of the Physical and Natural History Society of Geneva for the year 1914, shows that the activities of the society have not been seriously affected by the war. The society consists of sixty-six ordinary members and about the same number of honorary and free members. The scientific papers for the year cover sixty-

four pages, and are chiefly devoted to physics. Amongst the most important are Prof. Tommasina's contributions to theoretical physics, mainly criticising the theory of relativity, and the measurements of the electronic charge by MM. Schidlof and Karpowicz. Using drops of mercury of radii between 10^{-4} and 10^{-5} centimetre produced by an atomiser, they find that the light falling on the drops causes an appreciable amount of evaporation, and in consequence a variable speed of fall in a constant electric field. They also find that Cunningham's expression for the speed of fall of drops is not applicable to drops of the size used. The experiments, which are not yet complete, lend no support to the contention of Ehrenhaft that electrical charges exist, not integral multiples of the electron.

An important paper on the preparation and digestive properties of papain is communicated from the laboratory of organic chemistry, Bureau of Science, Manila, by Mr. David S. Pratt; it is published in the *Philippine Journal of Science* (vol. x., p. 1). Papain is the name given to the proteoclastic enzyme elaborated by *Carica papaya*, L., and is secreted in the milky latex that forms a prominent characteristic of the plant. The methods in use for preparing and drying the latex are described in some detail, and its digestive activity studied; suggestions are made for standardising the methods of evaluation. Although the market is in a way a limited one, the possibility of establishing a papain industry in the Philippine Islands should receive attention, as it does not necessitate a large investment of capital, and the time required is short before returns may be expected.

Science Progress for July contains papers on the structure of the universe by Mr. H. Spencer Jones (see NATURE, July 15, p. 548), on the molecular structure and mode of oxidation of carbon, by Mr. Maurice Copisarow; on the *rôle* of reductase in tissue respiration, by Profs. D. F. Harris and H. J. M. Creighton; on some eugenic aspects of the war, by Mr. A. G. Thacker; and on the spinning properties of cotton, by Mr. W. Lawrence Balls. A short paper by Mr. S. C. Bradford gives the history of adrenalin, the active principle of the suprarenal capsules; the story of the discovery of their function, followed by the isolation of the active principle, the determination of its structure, and its subsequent synthesis, is one of the most fascinating chapters in the history of biochemistry and in the application of modern organic chemistry to therapeutics. The present number of *Science Progress* contains a novel feature in the form of short reports by various specialists on recent advances in science. These reports are to be continued every quarter, and should prove not one of the least valuable features of our contemporary.

OUR ASTRONOMICAL COLUMN.

ASTROGRAPHIC CATALOGUE, PERTH SECTION.—The Perth Observatory of Western Australia was assigned a region of the sky for the construction of the great Astrographic Catalogue distributed among observatories situated all over the world. The section which was undertaken was that lying between 31° and 41° of south declination. The publication of the volumes containing the measures will be issued in thirty-six volumes, each containing six hours of right ascension for one degree of declination, but the volumes will not necessarily be published in numerical rotation. Under the direction of the Acting Government Astronomer, Mr. H. B. Curlewis, four volumes of measures have recently been issued, and these cover the regions summarised in the following table :—

Vol.	Right Ascension h. h.	Dec. of centre of plate °	Number of stars
IX.	0–6	−34	6,262
X.	6–12	−34	22,475
XI.	12–18	−34	20,498
XII.	18–24	−34	14,793

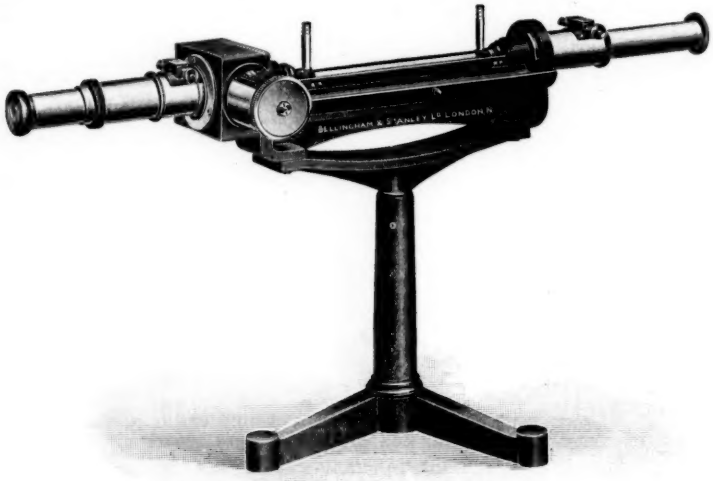
Issued with these volumes is vol vi. of the meridian observations containing a catalogue of 2025 stars between 37° and 39° south declination. These stars were selected as reference points for the Astrographic Catalogue, and are distributed approximately at the rate of three per square degree. Another volume consists of tables prepared for use in connection with zones 32° to 40° south declination. These tables are published in order that they may be readily accessible to those who are working in these zones. They are for the conversion of R.A. and declination, into standard conductors and of standard co-ordinates into R.A. and declination for plates having their centres in each of the above-mentioned degrees.

THE SCINTILLATION OF STARS.—A valuable article on the scintillation of stars and the unsteadiness ("boiling") of the instrumental image is contributed by M. G. Bigourdan, of the Paris Observatory, to the Bulletin of the French Astronomical Society (June). M. Bigourdan attempts to demonstrate their identity. In comparing the two phenomena the effect of stellar type, aurora borealis, and magnetic perturbations, barometric pressure, proximity of clouds, influence of azimuth, and of twilight, are separately considered. There are no data regarding effect of azimuth on tremor of image, and the effect of twilight appears to be to *increase* scintillation and decrease boiling, otherwise the two phenomena, it is concluded, present a true parallelism. Double-star observers are recommended to keep records of the degree of scintillation.

THE UNIVERSITY OBSERVATORY, OXFORD.—The fortieth annual report of the Savilian professor of astronomy shows that the activity of this institution has been well maintained during the period 1914–15. The analysis of meteorological statistics in pursuit of periodicities has been continued, and a cycle of 41–2 years has been traced in rainfall, etc.; in this direction there has been opened up an unlimited vista of work. The director has continued to control the earthquake station at Shide, and very pertinently suggests that the work of the Oxford University might well be extended in the direction of geophysics. In connection with the International Chart several Belgians resident in Oxford have rendered assistance in the measurement of star photographs. The distribution of stars according to magnitude has been determined for the Oxford, Bordeaux, Algiers, Cape, and Perth zones. Regional differences in the ratio of faint to bright stars thus revealed suggest the local presence of obscuring matter, and, when due allowance is made for this phenomenon the ratio seems to vary to a slight extent with galactic latitude.

A NEW SACCHARIMETER.

ONE of the many optical instruments which the English opticians have allowed the Germans to supply almost entirely is the saccharimeter. This instrument used to be made by Browning, but in late years nearly every instrument purchased in England has come from Berlin from the firm of Schmidt and Haensch, who make several designs of large and small instruments. It is therefore a pleasure to find an English firm—Messrs. Bellingham and Stanley, of London—making a saccharimeter which introduces valuable improvements on the German design. The one to which we refer is of the half-shadow type with quartz compensating wedges, but instead of the usual long wedge of which the movement is read direct by a scale and vernier, this one has a short wedge of larger angle. The wedge is moved by a screw, and the movement is read on a large drum with an open scale and sliding pointer.



New short-wedge saccharimeter.

The whole length of the scale is some 2 ft. instead of 1½ or 2 in., and it can thus be read with great ease.

In instruments making use of a quartz wedge of the usual length (about 3 cm.), the scale is nearly always uneven, and unless calibrated introduces errors amounting to several tenths of a degree Ventzke. According to Landolt this is due to the quartz, which he describes as "a poor material optically"; he says that one seldom finds faultless plates, and that a pure wedge 3 cm. long is rare. Hence the value of the short wedge of Bellingham and Stanley which is less than half the usual length. The advantage of such a wedge, even if the quartz is not of special quality, is greater than would appear at first sight, since the field is due to the *average* effect of the whole of the light passed through the wedge, and this average will vary evenly through the small change of area of the wedge due to its movement, and thus the scale will be regular in spite of variations in the quartz; also it is easier to get repeated readings, owing to the greater ease with which the setting can be made with the fine adjustment given by the series, as compared with the usual rack and pinion motion. In fact, the makers state that they have not detected any calibration errors in their instruments.

Another valuable feature is the enclosure of the scale and all working parts, so that they are protected from the salt vapours. The importance of this needs no emphasis to those who have had experience with instruments of this character. The corrosion of the

Scale of saccharimeter.

metal work—especially steel work—and of the scale, when as in the higher priced instruments this is engraved on silver or nikelin, under the action of the fumes in a laboratory often renders the instrument almost unusable in a few years. The instrument is mostly constructed of an aluminium alloy, protected by a black-stoved enamel, and no steel is used except for a small spring, which is entirely enclosed.

The optical work is of the first quality. The dividing line is sharp and clean, and the field evenly illuminated, so that adjustment for equality can be made without ambiguity, and with corresponding accuracy. The makers calibrate the scale at a number of points by direct reading against a polariser rotated on a divided circle. In the instrument examined the divisions were in half degrees "Ventzke" (of which 100 correspond to 34·68° of arc, for sodium light at 17·5° C.), and it was easy to estimate to tenths of a degree, *i.e.* to less than three minutes of arc. The design and workmanship were all that could be desired.

The same firm is also making refractometers of the Abbe and Pulfrich type and other optical instruments.

OUR OVERSEAS MUSEUMS.

THE British Museum, the parent and model of the museums scattered throughout our Empire, stands alone in that it has no journal of its own wherein to record the work done by its staff, though from time to time special memoirs and reports are published by the Trustees. There is much to be said for the publication of a museum journal, and not the least important of its functions would be to afford the general public an index of the magnitude and scope of its work, which can now only be estimated by laborious compilation from the annual "blue-book" or the publications of the various learned societies.

A measure of the nature of the work performed by the staff of a properly organised museum can be gauged by a survey of the journals and "records" relating to the museums of our colonies and of our Indian Empire. For the most part the contents of such journals are of necessity of a highly technical

character, as, for example, the series of papers in the "Records of the Indian Museum" for April. If any of these are to be chosen for special mention it must be the profusely illustrated "Contribution to a Knowledge of the Terrestrial Isopods of India," by Mr. W. E. Collinge, describing a collection of species new to science from the Madras Province of Southern India.

The *Journal* of the Federated Malay States Museums for March contains a valuable paper on the zoology of Koh Samui and Koh Pennan by Messrs. H. C. Robinson and C. Boden Kloss, and another on the plants therefrom by Prof. H. N. Ridley; while the April number contains a most interesting summary of Malay filigree work by Mr. I. H. N. Evans.

The thirteenth report of the Sarawak Museum contains a complete list of all the mosquitoes known from Borneo. The material for this was collected by the curator, Mr. J. C. Moulton—now on active service in France—and determined by Mr. F. W. Edwards, of the British Museum.

The Report of the South African Museum contains a brief summary of the acquisitions of the Geological Department, some of which are of considerable importance, as, for example, the remains of a small dinosaur from Bushmanland, apparently allied to the Cretaceous dinosaurs, and which throw light on the age of the old land surface in the north-west of the Cape Province.

The Records of the Albany Museum for May contains seven papers, one of which, on the fleas infesting various wild South African mammals, may prove of more importance than would appear at first sight.

All these institutions appear to be in a flourishing condition, but this is evidently far from true of the Rhodesia Museum, Bulawayo, which, in its thirteenth annual report, complains bitterly of the lack of funds. So seriously has its income fallen off that it has been necessary not only to reduce its staff, but to suspend even work necessary to ensure the well-being of the collections. We trust that better days are in store for the Albany Museum.

ENTOMOLOGICAL WORK IN CANADA.

RECENT publications of the Entomological Branch of the Canadian Department of Agriculture illustrate the wide field of the activities of Dr. Gordon Hewitt and his staff and the advances they are making in our knowledge of the control of insects.

In the *Canadian Entomologist* for March, 1915, Dr. Hewitt discusses the hibernation of the house-fly in a paper that is of very great topical value at the moment in this country; he finds that the maggots pupate at depths up to 2 ft. below and away from a manure heap, where this is situated on sandy loam; he finds also that the flies emerge from this situation. Discussing the hibernation of the insect, he reiterates his belief that it is as the adult that they live over the winter in northern latitudes.

In the Transactions of the Royal Society of Canada for September, 1914, Dr. Hewitt describes observations on the feeding of the stable-fly, *Stomoxys calcitrans*, which will be of value to those seeking to fix the rôle this insect plays in the dissemination of disease, notably of infantile paralysis.

A circular of the Department of Agriculture contains the instructions to importers of trees, plants, and other nursery stock into Canada; it explains clearly and simply what the importer has to do, and reprints the text of the Act. Another circular deals with the control of locusts in eastern Canada; the author, A. Gibson, uses the term locust for grasshopper, whereas it is better restricted to the migratory grasshoppers; but the circular is for popular use, and the term is probably so used in eastern Canada.

The most interesting point is the value of adding lemon juice to the poisoned bait for killing the insects; the method originated in Kansas, and works well in Canada.

In Bulletin No. 9 Mr. Gibson deals with the Army worm *Cirphis unipuncta*, an insect which caused a loss of 50,000*l.* in Ontario alone. He emphasises the great importance of co-operation among farmers in dealing with outbreaks promptly and thoroughly by means of trenching, poisoning, and rolling. It is possible that something better could be done with moth trapping on the "Andres Maire" system, which has proved successful elsewhere. The bulletin is a thoroughly practical, useful piece of work, and the Department evidently has the confidence of the farming community in Canada. H. M. L.

THE SUPPLY OF OPTICAL GLASS.

THE subject of the supply of optical glass and the needs and opportunities offered to the optical trade, by war and after-war conditions, still continues to attract the attention which it deserves. On July 16 an important conference was held at the London Chamber of Commerce between the Court and representatives of the Spectacle Makers' Company and representatives of the chamber and of the trade. The conference was convened by the company, and the chair was taken by the master, Sir J. F. L. Rolleston, M.P. There were also present Lord Southwark, president of the Chamber of Commerce, Viscount Hill, Sir William Hart Dyke, Sir Marcus Samuel, Dr. R. M. Walmsley, and others. The chairman opened the proceedings, and in the course of his speech explained how the debate in the House of Commons on optical matters which was initiated by Sir Philip Magnus on May 19, and in which several well-informed members, including the chairman, were prepared to take part, was interrupted and practically closured by the Prime Minister's very important announcement on "Coalition Government." He also referred to various matters to which we have directed the attention of our readers as they arose.

Lord Southwark, in opening the discussion, referred to the fact that he was not only the president of the chamber, but also a past-master of the Skinners' Company, which is so closely associated with the Northampton Polytechnic Institute and its work. He emphasised the importance of concerted action and the help which the City companies could give, and referred also to the valuable assistance which could be rendered by the chamber. In the discussion which followed, it was understood that the remarks made by trade members should not be reported. Dr. Walmsley, who was called upon to speak early in the debate, explained the points referred to in his letter to the *Times* of April 28, and indicated the importance of the opportunities which have now arisen for the recapture of those branches of the optical instrument trade which were so heavily handicapped before the war. He pointed out that this was worthy of a very earnest effort, and he referred particularly to the value of the trade in the employment of highly skilled labour, which forms so important an item in the production of complicated optical instruments, such as microscopes, etc. He also dwelt upon the necessity for training designers and computers. The importance of the spectacle-making branch of the trade was fully insisted upon, and eventually it was decided, on the motion of Lord

Southwark, at the suggestion of Sir William Hart Dyke, to appoint a joint committee of the Spectacle Makers' Company and the London Chamber of Commerce to study the questions at issue in all their bearings.

THE GOVERNMENT SCHEME FOR THE ORGANISATION AND DEVELOPMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH.

WE gave in our issue of May 20 a detailed report of speeches made in the House of Commons when the Government scheme for the formation of an Advisory Council concerned with industrial and scientific research was outlined by Mr. J. A. Pease, then President of the Board of Education. Since that time Mr. Arthur Henderson has succeeded Mr. Pease at the Board, and he has just issued as a White Paper (Cd. 8005, price ½d.) a statement of the need and nature of a scheme which will secure scientific foundations for national industries in the future. The paper is here reprinted.

(1) There is a strong consensus of opinion among persons engaged both in science and in industry that a special need exists at the present time for new machinery and for additional State assistance in order to promote and organise scientific research with a view especially to its application to trade and industry. It is well-known that many of our industries have since the outbreak of war suffered through our inability to produce at home certain articles and materials required in trade processes, the manufacture of which has become localised abroad, and particularly in Germany, because science has there been more thoroughly and effectively applied to the solution of scientific problems bearing on trade and industry and to the elaboration of economical and improved processes of manufacture. It is impossible to contemplate without considerable apprehension the situation which will arise at the end of the war unless our scientific resources have previously been enlarged and organised to meet it. It appears incontrovertible that if we are to advance or even maintain our industrial position we must as a nation aim at such a development of scientific and industrial research as will place us in a position to expand and strengthen our industries and to compete successfully with the most highly organised of our rivals. The difficulties of advancing on these lines during the war are obvious and are not under-estimated, but we cannot hope to improvise an effective system at the moment when hostilities cease, and unless during the present period we are able to make a substantial advance we shall certainly be unable to do what is necessary in the equally difficult period of reconstruction which will follow the war.

(2) The present scheme is designed to establish a permanent organisation for the promotion of industrial and scientific research.

It is in no way intended that it should replace or interfere with the arrangements which have been or may be made by the War Office or Admiralty or Ministry of Munitions to obtain scientific advice and investigation in connection with the provision of munitions of war. It is, of course, obvious that at the present moment it is essential that the War Office, the Admiralty, and the Ministry of Munitions should continue to make their own direct arrangements with scientific men and institutions with the least possible delay.

(3) It is clearly desirable that the scheme should operate over the kingdom as a whole with as little regard as possible to the Tweed and the Irish Channel. The research done should be for the kingdom as a whole, and there should be complete liberty to utilise the most effective institutions and investigators available, irrespective of their location in England, Wales, Scotland, or Ireland. There must therefore be a single fund for the assistance of research, under a single responsible body.

(4) The scheme accordingly provides for the establishment of :—

(*a*) A Committee of the Privy Council responsible for the expenditure of any new moneys provided by Parliament for scientific and industrial research;

(*b*) A small Advisory Council responsible to the Committee of Council and composed mainly of eminent scientific men and men actually engaged in industries dependent upon scientific research.

(5) The Committee of Council will consist of the Lord President, the Chancellor of the Exchequer, the Secretary for Scotland, the President of the Board of Trade, the President of the Board of Education (who will be vice-president of the Committee), the Chief Secretary for Ireland, together with such other Ministers and individual Members of the Council as it may be thought desirable to add.

The first non-official members of the Committee will be :—The Right Hon. Viscount Haldane of Cloan, O.M., K.T., F.R.S., the Right Hon. Arthur H. D. Acland, and the Right Hon. Joseph A. Pease, M.P.

The President of the Board of Education will answer in the House of Commons for the sub-head on the Vote, which will be accounted for by the Treasury under Class IV., Vote 7, "Scientific Investigations, etc."

It is obvious that the organisation and development of research is a matter which greatly affects the public educational systems of the kingdom. A great part of all research will necessarily be done in universities and colleges which are already aided by the State, and the supply and training of a sufficient number of young persons competent to undertake research can only be secured through the public system of education.

(6) The primary functions of the Advisory Council will be to advise the Committee of Council on :—

(i) Proposals for instituting specific researches;

(ii) Proposals for establishing or developing special institutions or departments of existing institutions for the scientific study of problems affecting particular industries and trades;

(iii) The establishment and award of research studentships and fellowships.

The Advisory Council will also be available, if requested, to advise the several Education Departments as to the steps which should be taken for increasing the supply of workers competent to undertake scientific research.

Arrangements will be made by which the Council will keep in close touch with all Government Departments concerned with or interested in scientific research and by which the Council will have regard to the research work which is being done or may be done by the National Physical Laboratory.

(7) It is essential that the Advisory Council should act in intimate co-operation with the Royal Society and the existing scientific or professional associations, societies, and institutes, as well as with the universities, technical institutions, and other institutions in which research is or can be efficiently conducted.

It is proposed to ask the Royal Society and the principal scientific and professional associations, societies and institutes to undertake the function of initiating proposals for the consideration of the Advisory Council, and a regular procedure for inviting and collecting proposals will be established. The Advisory Council will also be at liberty to receive

proposals from individuals and themselves to initiate proposals.

All possible means will be used to enlist the interest and secure the co-operation of persons directly engaged in trade and industry.

(8) It is contemplated that the Advisory Council will work largely through Sub-Committees reinforced by suitable experts in the particular branch of science or industry concerned. On these Sub-Committees it would be desirable as far as possible to enlist the services of persons actually engaged in scientific trades and manufactures dependent on science.

(9) As regards the use or profits of discoveries, the general principle on which grants will be made by the Committee of Council is that discoveries made by institutions, associations, bodies, or indviduals in the course of researches aided by public money shall be made available under proper conditions for the public advantage.

(10) It is important in order to secure effective working that the Advisory Council should be a small body, but it is recognised that even if full use is made by the Council of its power to work through reinforced Sub-Committees, its membership may be found inadequate to do justice to all the branches of industry in which proposals for research may be made or to the requests of other Government Departments for assistance. It is therefore probable that it will be found necessary to strengthen the Council by appointing additional members.

The first members of the Council will be:—The Right Hon. Lord Rayleigh, O.M., F.R.S., Mr. G. T. Beilby, F.R.S., Mr. W. Duddell, F.R.S., Prof. B. Hopkinson, F.R.S., Prof. J. A. M'Clelland, F.R.S., Prof. R. Meldola, F.R.S., Mr. R. Threlfall, F.R.S., with Sir William S. M'Cormick as administrative chairman.

(11) The Advisory Council will proceed to frame a scheme or programme for their own guidance in recommending proposals for research and for the guidance of the Committee of Council in allocating such State funds as may be available. This scheme will naturally be designed to operate over some years in advance, and in framing it the Council must necessarily have due regard to the relative urgency of the problems requiring solution, the supply of trained researchers available for particular pieces of research, and the material facilities in the form of laboratories and equipment which are available or can be provided for specific researches. Such a scheme will naturally be elastic and will require modification from year to year; but it is obviously undesirable that the Council should live "from hand to mouth" or work on the principle of "first come first served," and the recommendations (which for the purpose of estimating they will have to make annually to the Committee of Council) should represent progressive instalments of a considered programme and policy. A large part of their work will be that of examining, selecting, combining, and co-ordinating rather than that of originating. One of their chief functions will be the prevention of overlapping between institutions or individuals engaged in research. They will, on the other hand, be at liberty to initiate proposals and to institute inquiries preliminary to preparing or eliciting proposals for useful research, and in this way they may help to concentrate on problems requiring solution the interest of all persons concerned in the development of all branches of scientific industry.

(12) An Annual Report, embodying the Report of the Advisory Council, will be made to his Majesty by the Committee of Council and laid before Parliament.

(13) Office accommodation and staff will be provided for the Committee and Council by the Board of Education.

MODERN MUNITIONS OF WAR.[1]

I.—GUNS AND PROPELLANTS.

ELEVEN months of war have now passed, and certain lessons have made themselves perfectly clear. The teaching of the first six months of the war was tersely summed up by General French when he said last February, "The problem set is a comparatively simple one—munitions, more munitions, always more munitions," the special munitions meant in this case being the high explosive shells that from the time the war assumed the conditions of a field siege after the battle of the Aisne became a necessity for any advance.

By "munitions" are meant practically everything required by the Army, and it will be well first to consider the wonderful changes which have taken place in guns and propellants, and which in this war have made artillery probably the most important feature.

Napoleon, himself an artillery officer, was fond of using massed batteries in much the same way as artillery is being used in the present war, but what artillery meant in those days and in these can perhaps be best grasped by remembering that the old *Victory*, which was our most heavily armed ship in the Napoleonic days, had a broadside of 52 guns, which, when fired simultaneously, would have thrown about 60 per cent. of the weight of the metal contained in one shot from the 15-in. guns of the modern super-Dreadnoughts. We must also remember that in the Crimean War the old smooth-bore 68-pounders, using a charge of 16 lb. of black powder, were the largest guns ashore or afloat at the time, whereas now we have the 15-in. guns of our super-Dreadnoughts, weighing close on 100 tons, from which a charge of 400 lb. of MD cordite hurls a projectile weighing 1925 lb. with accuracy to a distance of fifteen miles, or with high angle firing to double that distance.

The changes commenced in the 'fifties of the last century, when we adopted the idea of rifling ordnance so as on firing the gun to give the projectile a spin as well as forward velocity, this being found to add to the range and accuracy of fire, and in order to do this satisfactorily the guns had to be increased in length.

The rate at which the size of the big naval guns grew may be gathered from the fact that at the Siege of Alexandria in 1882 we had the 80-ton guns of 16-in. calibre, whilst by 1886 we had afloat the 110-ton guns with a bore of 16·25 in., using a charge of 960 lb. of powder. It was soon found, however, that the lengthening of the gun when using the form of gunpowder then employed caused a strain on the breech and gave but a low muzzle velocity, this being due to the rapid burning of the powder. Attempts were then made to slow the combustion of the powder by increasing the size of the grain, and with the increase in the size of the guns the powder gradually grew to the large pebble powder, consisting of 1¾-in. cubes. Unfortunately the desired effect could not possibly be obtained by alterations of this character, as it is required of a perfect powder that when the charge is fired in the breech of the gun, the combustion shall commence comparatively slowly, so as to overcome the *vis inertiae* of the projectile without throwing too great a strain on the gun, and the combustion of the powder should then increase in rapidity so as to supply gas more and more rapidly to increase the pressure and momentum of the shot, which should leave the muzzle of the gun with the maximum velocity.

With such forms of powder as cubes or other large

[1] Abstracts of three lectures delivered at the Royal Society of Arts on July 7, 14, and 21, by Prof. Vivian B. Lewes.

grain, however, maximum rapidity of burning and evolution of gas takes place at first, owing to the ignition spreading over the whole surface of the cubes, and instead of the gas coming off with more and more rapidity as the space in the gun became larger, the evolution rapidly diminished with the decrease of surface caused by the burning away of the powder.

In order, so far as possible, to avoid this defect, built-up charges were resorted to, and it was General Rodman, of the American Service, who first tried to overcome the difficulty by building up the charge of solid slabs perforated with holes, from the interior of which the combustion was started, so as to expose the minimum surface of powder at first, whilst the enlarging holes produced a greater and greater surface of powder as the space behind the projectile increased.

Large perforated cakes, however, are always liable to break, and cannot be made of uniform density, so that it was found far better to mould the powder into hexagonal prisms with a central core through them, which could be built up into a charge, the prisms being made with such exactitude that when the charge was fired by a layer of fine grain powder at the base of the cartridge the combustion started from the central cores, and as the powder burnt away a greater and greater surface for combustion was continually formed until the whole of the charge was spent.

With the continued growth, however, in the size of the guns employed other changes became necessary, as even when using the black prism powder for built-up charges the pressure given began to throw too severe a strain upon the breech of the gun, even when the cartridges were made up in such a way as to leave air spaces at the seat of the charge. In order to relieve the initial pressure so far as possible, and to secure further modifications, alterations in the composition of the powder became necessary, so that by the time the 80- and 110-ton guns were introduced into the Naval Service prism powder containing an increased percentage of potassium nitrate and charcoal with a smaller proportion of sulphur were in use.

This fitting of the powders to the guns enabled perfect ballistics to be obtained, and really converted the explosive into what Sir Frederick Nathan was fond of calling these powders—"propellants." These powders had one characteristic, however, in common with the old grain powder, and that was that they gave volumes of smoke, and when rapid-firing guns were introduced so dense was the cloud produced that after the first few rounds nothing could be seen, and the guns became useless until the smoke had cleared. This rendered a smokeless powder a necessity, and the history of the inception of the smokeless powders of to-day is full of interest.

In any successful explosive certain conditions have to be fulfilled; one must be able to concentrate in a small space bodies which will act upon each other independent of the air with enormous rapidity, forming the largest possible volumes of gas, which, expanded by the heat of the action and having to find a way for itself, gives the explosive effect. If this change takes an appreciable time, the body can be used as a "propellant" in a gun, and gunpowder is of this character. When, however, the change takes place practically instantaneously, it cannot be used in a gun, and is used in high-explosive shells, bombs, torpedoes, and mines; and such bodies we call "high explosives," nitroglycerin being an example of this class.

When during the formation of the gas from the solid in explosion other solid compounds are formed as well, these solids are blown out in a fused form as fine particles and form a cloud-smoke, but, if only gases are produced, the explosion is smokeless. Gunpowder on being fired gives nearly half its weight as solids and therefore forms clouds of smoke; guncotton is resolved entirely into gases and gives no smoke.

When the necessity for a smokeless powder became urgent, it was naturally to nitro-cotton, discovered by Schonbein in 1845, that attention was most largely turned, but all attempts to convert it from an "explosive" to a "propellant" failed until it was discovered that its rate of combustion could be slowed down sufficiently to make an excellent propellant by destroying the original cotton structure that still existed in the nitro-cotton by gelatinising it with alcohol and ether, so forming a grain that can only burn from the exterior. If cotton fibre is examined under the microscope it is found to consist of very minute tubes, and in the process of converting the cotton into "guncotton," by soaking it in a mixture of the strongest nitric and sulphuric acids, washing out all acid and drying, this structure remains. If the guncotton were used as a charge in a big gun, no matter how much it was compressed, the flame of the combustion would be driven back into these tubes and so accelerate the burning as to give almost instantaneous explosion, straining the gun and giving very low velocity to the projectile.

Nitroglycerin is an even more rapid explosive than guncotton, and if used in a gun would burst it, probably without driving out the projectile at all. Nobel, however, in 1875 discovered that if a low form of guncotton was macerated in nitroglycerin the guncotton was gelatinised, all structure disappeared, and both explosives became so tamed in their action that they were converted into a perfect blasting explosive; and in 1888 the mixture was made the basis of a smokeless propellant far superior to gunpowder. This idea was improved upon by Sir Frederick Abel and Sir James Dewar, who found that the highest form of guncotton, which is unacted upon by nitroglycerin, could be got into a gelatinised mass with nitroglycerin if a common solvent, such as acetone, was used to blend them, and afterwards evaporated out, and this blend with 5 per cent. of vaseline to increase the stability and lubricate the gun forms our modern "propellant" cordite, so named from the fact that it is cast into sticks, rods, or cords, according to the size of the gun in which it is to be used.

The "Mark I" cordite first made contained 68 per cent. of nitroglycerin, and the heat of its combustion in the guns gave rise to a troublesome form of erosion, which in the South African war shortened the lives of the field guns, which had to be re-lined after a certain number of rounds had been fired, and this led to an alteration in the proportion of the ingredients in the MD cordite now used in all arms, from the 15-in. guns of our super-Dreadnoughts to the Service rifles.

Our Allies and enemies alike use smokeless powders of a somewhat different type, made by gelatinising nitro-cotton without any nitroglycerin for their field artillery and rifles, but in the German and Austrian naval guns nitroglycerin powders of much the same kind as our "cordite" are used, as a larger charge of nitro-cotton powder has to be employed than of a nitroglycerin powder, and this means larger chambers in the guns and larger magazines to carry the necessary amount of explosive.

As may be imagined, the introduction of smokeless powder made an immediate change in gun construction, as much smaller chambers were needed, and the possibility of throwing the pressures further forward in the gun enabled them to be made lighter, and as a result our biggest naval guns are only 15 in. as against the 16·25-in. 110-ton guns in use in 1886, and the charge of MD cordite only 400 lb. as against the 960 lb. of prism powder, but the muzzle velocity has

increased by nearly 50 per cent., whilst the projectile is far heavier.

Our enemies in the field are using guns, howitzers and mortars, the two latter classes being used for indirect fire from behind shelter, for which their high trajectory specially fits them, whilst the field artillery used by them are chiefly quick-firing 77-millimetre guns (3·03 in.). One of the new features they have introduced into the present warfare is the use of siege guns of much larger size, transported by motors, and so made available for field work, whilst amongst the other artillery in use are the celebrated Krupp siege howitzers of 16·8 in. calibre, but probably the most deadly innovation has been the almost unlimited use of machine guns, to the perfecting of which the Germans have devoted many years, and of which they have an enormous supply.

II.—Shells and High Explosives.

The shells used in big guns and field artillery may be divided into two main classes: shrapnel, which is utilised against troops in the field, and is of but little use against fortifications or trenches, and high explosive shells, which may be either armour-piercing or ordinary.

The shrapnel shell is a hollow cylindrical steel projectile packed with bullets, at the base of which is a bursting charge that may be gunpowder or high explosive, whilst in the nose of the shell is arranged the time fuse connected by a tube to the bursting charge, and so regulated that the shell can be exploded in the air at any desired point, the bullets and fragments of the shell being driven forward and spreading over a considerable area. The shrapnel used in the ordinary field gun is an 18-lb. projectile, containing 375 bullets, and when burst at the right altitude is a most deadly weapon against troops, especially when in massed formation. Since its invention by the officer whose name it bears, shrapnel has been looked upon in the Service as the form of shell most necessary in field operations, and during the present war our supplies have been ample for all requirements.

For fortified trench warfare, such as has been the characteristic feature of the fighting on the western front since September, shrapnel is not effective, as it does but little damage to earthworks, wire entanglements, and other defences, and this practically new phase of field warfare has to be met by the use of high-explosive shells, capable of detonating with such enormous concussive power as to destroy physical obstructions, crumble earthworks, clear wire entanglements, and reduce the defenders in the trenches to a dazed and stunned condition by the action of concussion on the heart and nerves.

Under the conditions created in the present war both classes of shells are needed in the field—the shrapnel to resist infantry attack, the high-explosive shells to clear the ground and prepare the way for attack on the enemy, and it has been an insufficiency in the supply of the latter which has given rise to so much criticism, mostly undeserved and wholly unwise. At the present time obstacles to supply in all directions have been surmounted, and a steady and ever-increasing stream of shell is flowing to the front.

The high-explosive shell is made of forged steel with comparatively thin walls and a heavy bursting charge, but the large naval shells and those for the siege guns, which have to penetrate heavy armour, are made from ingots of chrome or chrome-nickel steel, forged, hardened, and the nose capped with soft steel, which prevents the shell from shattering on impact with the hardened steel armour. These shells also contain a heavy charge of high explosive, generally cast into the shell in a fused condition.

All these forms of shell are fitted with the usual soft copper driving bands near the base of the shells; these bands take the place of the projections used in the early forms of shell to fit the rifling of the gun. The copper band, under the pressure existing during the firing of the charge, is pressed into the grooves of the rifling in the gun, not only imparting rotation to the projectile, but also acting as a gas check to prevent the rush of the gas past the projectile, an action which had accentuated the serious erosion with Mark I cordite.

For trench fighting the grenade has now again come into use, and the most modern forms are in reality miniature shrapnel shells, which are fitted on to a rod that can be fired from a rifle, or, where the trenches are close together, can be thrown or slung by hand. The body of the grenade is made of steel or malleable iron so serrated as to break up on explosion into many pieces; it contains a charge of T.N.T., and a tetryl detonator fired on impact by a needle liberated only after the grenade has travelled a certain distance, so as to render premature explosion impossible. The weight of such a grenade is about 23 oz., and when fired its range would be about 300 yards, but when hand-thrown not more than 40 or 50, and its flight through the air is steadied when fired by a rod, which for hand use is replaced by a rope tail.

One of the things that strikes the ordinary observer most when considering the composition of the explosives of to-day is that they are all derived from substances of the most commonplace and harmless description, and probably the greatest mistake the Government has made in this war was in not making cotton contraband from the commencement, and it is inexcusable that the mistake should not be rectified.

There is not the least doubt that Germany had enormous supplies of cotton at the commencement of the war, as well as huge quantities of manufactured explosive, but the factor which she had omitted to reckon on was the duration of the war, which was expected to be over last November. It has been calculated that Germany and Austria need 1000 tons of cotton a day, and it has been proved that the neutral European countries—Holland, Denmark, Sweden, and Norway—imported during the first three months of this year six times the amount they did in the corresponding period of last year, and there can be but little doubt as to where this enormous surplus went.

Directly there is any talk of making cotton contraband German articles appear in the Press of the neutral countries pointing out that it is not aimed at German explosives, but is England's attempt to corner the trade in textile fabrics, but for some inscrutable reason the Government has so far declined to do the one thing that more than any other would shorten the war.

We have seen that cotton and glycerin when nitrated and blended with vaseline yield cordite, which serves as a propellant in all our guns, whilst the high explosives used in shells, torpedo heads, mines, and aviators' bombs are almost entirely derived from coal-tar derivatives by nitration. When coal tar is subjected to fractional distillation the portion which comes over up to a temperature of 170° C. is called "light oil," and contains all the compounds of low boiling point found in the tar, and, as we shall see, from this several of our most valuable explosives can be obtained. When these light oils have distilled over the next fraction or "middle oil" yields phenol or carbolic acid, a body which when nitrated gives picric acid, the basis of the French high-explosive melinite, the Japanese shimose powder, and the English lyddite.

Picric acid is a nitro-substitution product, three atoms of the hydrogen of the original phenol being

replaced by the radical nitryl, NO_2, and it forms with metals a class of salts called "picrates." The potassium salt was suggested as a bursting charge for shells nearly fifty years ago, whilst Sprengel showed that picric acid itself could be detonated, and later Turpin employed the acid as an explosive. It was found possible to get a great weight of explosive into a small space, as the acid could be melted and poured into the shell in a molten condition. Picric acid *per se* is a very safe explosive, but has the drawback of acting on metals to form picrates, some of which are far more sensitive to disturbing influences than the acid itself.

Experiences with lyddite shells in the South African war showed their behaviour to be very erratic, some exploding with great effect, whilst others gave disappointing results, this being due to the fact that picric acid requires a powerful detonator for obtaining the highest explosive effect, and the use of such a detonator was dangerous, and might cause a premature explosion of the shell within the gun.

The disadvantages inherent in the use of picric acid led to attempts being made to replace it by some other material of the same character, which could be used as a high explosive in a bursting charge and yet be free from these drawbacks. Such a body was found in trinitrotoluol, and although its explosive force is slightly less than that of picric acid, the pressure of the latter being 135,820 lb. on the square inch, as against 119,000 for trinitrotoluol, yet its advantages more than compensate for this difference. Not being of an acid nature, trinitrotoluol, or T.N.T., as it is termed, cannot accidentally form more sensitive salts; it is without action on metals, and is perfectly stable.

The formation of volumes of black smoke on detonation of the T.N.T. has given rise to the names given to shells containing this explosive of "Black Marias," "coal-boxes," and "Jack Johnsons," and the fact that this cloud of carbonaceous matter is produced shows conclusively that the oxygen contained in the nitryl radical present in the explosive is insufficient for its complete combustion. An excellent explosive used during the Balkan war, and now largely employed by the Austrians, is known as ammonal, in which 12 to 15 per cent. of T.N.T. is mixed with an oxidising compound, ammonium nitrate, a little aluminium powder, and a trace of charcoal. This mixture gives even better results than the T.N.T. alone, and its only drawback is the hygroscopic character of the ammonium nitrate, which necessitates the material being made up in air-tight cartridges. It forms, however, a most effective bursting charge, and although the rate of detonation of the trinitrotoluol is reduced by the admixture of the oxidising compounds, the shattering effect is even more destructive than when the explosive is used alone, as the pieces of shell scattered are larger in size. An improved form of this explosive is being made on a large scale in England for use by the Allies, and renders the supply of high explosives for shells perfectly adequate.

Toluene is obtained from the crude benzol in coal tar and by scrubbing coal gas, by fractional distillation, and is also being produced synthetically from other hydrocarbons by the action of heat and pressure, so it is safe to say that any requirements for toluene to nitrate can be amply met.

Under the influence of nitration other constituents of tar are converted into effective explosives, dinitrobenzol being the basis of such mining explosives as "Roburite" and "Bellite," whilst trinitrocresol has been used largely in place of picric acid, under the name of "Ecrasite," but it shares with picric acid the drawbacks of forming more sensitive compounds with bases and of having an acid reaction.

Expert opinion has by no means settled which is really the best of the high explosives, and although it was the Germans who were chiefly responsible for bringing T.N.T. into such prominence, there are not wanting signs that they are largely reverting to picric acid.

Probably the most powerful explosive known is made from benzene by converting it into anilin, and by nitration making this into tetranitro-anilin, an explosive of which a great deal more will be heard, whilst another derivative tetranitromethylanilin, known as "tetryl," is being used largely for primers and detonators.

III.—Poison Gas and Incendiary Bombs.

There are many gases known which are irrespirable. Some, like carbon dioxide, nitrogen, and hydrogen, act merely in the same way as water would do by cutting off the oxygen supply, which is a necessity to life, from the lungs, but have no toxic action on the system. Other gases, like carbon monoxide and cyanogen, are powerful poisons, less than 1 per cent. of which in the air will cause death by purely toxic action. Others again, like sulphur dioxide, chlorine, and bromine, may act by producing spasms of the glottis, and subsequent asphyxiation.

The use of asphyxiating gas is by no means the simple problem that one might imagine. In the first place, gases differ from other forms of matter in that the molecules of which they consist being free from cohesion, are able to intermingle, no matter how different may be their weights, a process which is known as "diffusion," so that unless the gas is very considerably heavier than air it intermingles with the atmosphere so quickly as to prevent its spreading in a poisonous quantity over any considerable area. No gas which is not more than double the weight of air could be used effectively in sufficient quantity to be poisonous at the distances likely to exist between the trenches. It is this that accounts for the fact that although 1 per cent. of carbon monoxide is instantly fatal, no deaths can be traced to its effects during the war, although all our propellants and high explosives give on explosion large volumes.

The weight of a gas is represented by its density, that is, how many times it is heavier than hydrogen, the lightest gas known, and in the following table are shown the densities of the various gases suspected of having been used or possible to use, and the relation of their weight to an equal volume of air:—

	Density	Times heavier than air
Sulphur dioxide	32	2·21
Nitrogen tetroxide ...	46	3·17
Chlorine	35·5	2·45
Bromine vapour	80	5·53
Phosgene	50·6	3·49

By the laws of diffusion gases intermingle at a rate which is inversely proportional to the square roots of their densities, but air currents or wind enormously increase the rate of admixture, so that with anything like a breeze blowing it would be impossible to use them successfully, whilst the opportunity for "frightfulness" is, of course, limited by the direction of the wind, so that in Flanders it is only with the wind in the north or a point or two on either side that effective use could be made of them.

During the past few months the prevailing winds have been in the enemy's favour for considerably more than the normal period, and it is to be hoped that during the next few months with the prevalent wind from the south or south-west the opportunity of using these gases will be reduced to a minimum.

The inhalation of a very small proportion of sulphur dioxide gas causes coughing, four volumes in 10,000 of air rendering it irrespirable, but if the sufferer escapes from the zone within a reasonable period the effects pass off, and the inhalation of dilute ammoniacal fumes rapidly affords relief. The gas can be easily liquefied by cold or pressure, and one pound of the liquid gives roughly 5 cub. ft. of the gas. The liquid sulphur dioxide is being used by the enemy in hand-grenades, which, broken by a small bursting charge, scatter the contents when thrown into the opposition trench, when they immediately volatilise, and often contain other volatile irritant bodies besides the sulphur dioxide.

Chlorine, which in all probability is the gas which has been used to the greatest extent, is of a yellowish-green colour. It can be liquefied under a pressure of six atmospheres, and has an insupportable odour. When inhaled even in minute quantities it causes great irritation of the mucous lining of the throat and lungs, air containing from 2 per cent. of it rapidly proving fatal. This gas can be made with the greatest ease by heating a mixture of hydrochloric acid and black oxide of manganese, but it is now produced in large quantities in certain electrolytic processes, from which it can be collected and liquefied, the liquid being stored in lead-lined steel cylinders closed by a valve.

In such a cylinder the gas above the liquid exercises a pressure of at least 90 lbs. on the square inch, so that if a cylinder containing it be fitted with a tube which passes down into the liquid and is provided at its exit from the cylinder with a valve, on opening the valve the liquid is blown out in the form of a spray, which at atmospheric pressure instantly assumes the gaseous form, and it is in this way that it has been chiefly used. It is reported, however, that where the German trenches are of a more or less permanent character, broad tubes with valves at intervals are laid a few feet in front of the trenches with the openings pointed towards the Allies, the trunk tubes being connected with a gasholder and chlorine plant situated in a sheltered spot some little distance away, so that the mere opening of the valves sets free a flood of gas without the disturbing influence of the cooling effect produced when gas is liberated from a cylinder of compressed liquid. The yellow colour of the gas employed has been a marked feature of all the more serious gas attacks, but it must be remembered that either chlorine or nitrogen tetroxide would give very much this effect, although the latter would be browner in colour.

Nitrogen tetroxide constitutes the fumes formed during the action of nitric acid on various substances in contact with air, and can be liquefied at temperatures below 26° C. to a liquid varying in colour with the temperature. Most observers from the front insist that this gas has been largely used, but this seems doubtful, as nitric acid and the oxides of nitrogen play so important a part in the manufacture of explosives that in spite of the large quantities of nitric acid made by electrical processes from atmospheric nitrogen, the enemy cannot spare much for this purpose, more especially as chlorine is more effective and wickedly cruel in its action, and can be obtained in any desired quantity without affecting the supply of any other munitions of war.

Only two liquid elements are known, mercury and bromine, and the latter, which is closely allied to chlorine in all its properties, becomes a vapour at atmospheric temperatures, and boils at 59° C. Germany produces practically the whole European supply from traces of magnesium bromide found in the great salt mines at Stassfurt. It is a reddish-brown liquid, and gives a vapour of the same colour, which violently attacks the eyes as well as the mucous lining of the nose, throat, and lungs. Its effect upon the system is the same as that of chlorine, and it is supposed to have been used by the Germans in asphyxiating shells, the bursting of which would scatter the liquid bromine and facilitate its conversion into vapour, which owing to its great weight would sink to the ground.

A form of poisoning used by the enemy has been the use of amorphous phosphorus in the shrapnel shells used partly for the marking of ranges. Amorphous phosphorus is a violet-brown powder, largely used in the composition on safety-match boxes, and differs widely from yellow phosphorus in that it is non-poisonous, and inflammable only at a temperature that converts it into the inflammable yellow form. A small cartridge of this included in the 18-pounder shell is converted by the heat of explosion into the ordinary variety, which burns, giving a dense white fume of phosphorus pentoxide, which marks the position of the bursting shell by day, and has conferred upon this type of shell the name of "woolly bear," and a flame which performs the same function of marking the position by night. When, however, a fragment of such a shell inflicts a wound the phosphorus poisons it, and very serious complications ensue.

Probably the phase of "frightfulness" that interests the British public as much as any is the bombs dropped by aeroplanes and Zeppelins, of which several distinct varieties are in use.

Besides these, incendiary bombs are used, which differ somewhat from those used by the enemy, and which for manifest reasons cannot be discussed. The incendiary bombs used by the Germans consist of an outer skin wound round with tarred rope, and containing a charge composed of a mixture of very finely divided aluminium and oxide of iron, which when ignited develops an enormous amount of heat owing to the combination of the oxygen of the oxide of iron with the aluminium.

This mixture is known in trade as "thermit," and was successfully introduced for practical use by Goldschmidt in 1898; it is now largely used for welding rails and other iron and steel structures, and also for repairing castings, indeed, for any purpose for which intense local heating is desired. In many of these bombs there is a layer of amorphous phosphorus at the base, which converted into phosphorus vapour by the heat of the thermit reaction burns with a rush of poisonous flame, igniting everything around, giving burns which, if not fatal, are poisoned and most difficult to get to heal, and also producing a cloud of fumes of phosphorus pentoxide.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LIVERPOOL.—Prof. R. Robinson, of the University of Sydney, has been appointed to the newly constituted chair of organic chemistry. The University has recently received the sum of 10,000*l.* from Mr. Heath Harrison for the endowment of the chair. Prof. Robinson, who will fill the chair, was a student of the University of Manchester, where in 1909 he was appointed assistant lecturer. He is well known for his investigations in conjunction with Prof. W. H. Perkin on the constitution of brazilin and hæmatoxylin, the synthesis of narcotine, and the constitution of strychnine, brucine, harmine, harmaline, etc. He was appointed to the chair of organic chemistry at Sydney in 1912.

PROF. J. MASCART, director of the Lyons Observatory, informs us that the city of Lyons has commenced the formation of a War Library, to contain a collection of works and documents on the events of 1914-15.

The Mayor of Lyons hopes to secure as complete a collection as possible of papers relating to the war, so that students and investigators of diverse subjects—meteorologist or historian, hygienist or sociologist—will eventually regard it as the central bureau for their own particular studies of the times through which which we are now passing. All branches of human activity having relation to war questions or problems will be embraced by the library, and no article or other publication will be considered too unimportant for inclusion. It is hoped that authors of all contributions upon these subjects will send copies of their works to the Bibliothèque de la Guerre of the city of Lyons, and will co-operate in other ways to make the collection complete.

UNTIL recent years the personal side of academic scientific history has not attracted with us the general attention that its human interest deserves. A notable exception is, however, afforded by the accounts given in the biographies of Lord Kelvin of the relations between Glasgow and Cambridge in his early days. A very interesting narrative of about ten years later has now appeared in the form of a notice of G. M. Slessor, of Queens' College, senior wrangler of 1858, and for a few years professor at Belfast, a mathematician of well-known achievement, whose high promise was cut off by early death at the age of twenty-eight. The biography, accompanied by a striking portrait, is in the *Aberdeen University Review* for June, 1915; it is written by the Master of Emmanuel, Dr. P. Giles, largely from material contributed by Sir James Stirling, F.R.S., who was a pupil and friend of Slessor, and was himself an Aberdonian senior wrangler a few years later. It may be commended to the notice of all concerned with the preservation of the scientific and academic personal records of the period.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, July 19.—M. Ed. Perrier in the chair.—J. **Boussinesq**: The existence in our physico-mathematical sciences of fundamental chapters still in the same rudimentary state as the dynamics of Aristotle.—Georges **Lemoine**: The catalysis of hydrogen peroxide in homogeneous media with acids and alkalis. Pure water acts as a catalyser on hydrogen peroxide. The addition of acids even in very small proportions, some ten-thousandths, reduces the rate of decomposition. Curves are given showing the relation between rate of decomposition and concentration of acid for sulphuric and hydrochloric acids. Alkalis accelerate the rate of decomposition, and the results of experiments with soda, potash, and lithia are given.—C. E. **Guye** and Ch. **Lavanchy**: The experimental verification of the Lorentz-Einstein formula by kathode rays of high velocity. Using the method of identical trajectories described in an earlier paper it was found that the Lorentz-Einstein formula on the variation of the inertia as a function of the velocity was verified with great precision by all the measurements.—E. **Fleurent**: Remarks on bread for prisoners of war. A method of preparing bread is described giving a product not liable to mould, and preserving its flavour intact even after keeping a month or longer in a moist, dark cupboard.—Louis **Roule**: Fish from the lower depths of the sea of the family of Brotulideæ in the North Atlantic.—E. **Vasticar**: The nuclear formation of the external auditive cells and of Deiters cells.

BOOKS RECEIVED.

Chemistry of Familiar Things. By S. S. Sadtler. Pp. xiii+320. (Philadelphia and London: J. B. Lippincott Co.) 7*s.* 6*d.* net.

A Text-Book on Practical Mathematics for Advanced Technical Students. By H. L. Mann. Pp. xii+487. (London: Longmans and Co.) 7*s.* 6*d.* net.

Metropolitan Water Board. Eleventh Report on Research Work, together with Index to Research Reports. Nos. i.–x., inclusive. By Dr. A. C. Houston Pp. 52+vii. (London.)

How Belgium is Fed. Pp. 28. (London: National Commission for Relief in Belgium.)

The National Physical Laboratory. Report for the Year 1914–15. Pp. 136. (Teddington.)

The National Physical Laboratory. Collected Researches. Vol. xii., 1915. Pp. iv+173+plates. (London: Harrison and Sons.) 12*s.*

An Introduction to Mining Science. By J. B. Coppock and G. A. Lodge. Pp. ix+230. (London: Longmans and Co.) 2*s.* net.

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